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NEW HAMPSHIRE AGRICULTURE.

FIFTEENTH ANNUAL REPORT

OF THE

BOARD OF AGRICULTURE

FOR THE YEAR

FROM JUNE 1, 1885, TO JUNE 1, 1886.

By JAMES O. ADAMS, Secretary.

MANCHESTER:
JOHN B. CLARKE, PUBLIC PRINTER.
1886.

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BOARD OF AGRICULTURE.

ORGANIZED AUGUST 28, 1870.

MEMBERS.

MOSES HUMPHREY, *Chairman* . . .	Concord.
JAMES O. ADAMS, *Secretary* . . .	Boscawen.*
W. H. H. MASON	Moultonborough.
HIRAM PARKER	Lempster.
GEORGE K. HARVEY	Surry.
ALBERT DEMERITTE	Durham.
DAVID H. GOODELL	Antrim.
SIDNEY B. WHITTEMORE	Colebrook.
JOHN E. CARR	North Haverhill.
JOHN D. LYMAN	Exeter.
GEORGE S. PHILBRICK	Tilton.

Messrs. Humphrey and Mason were chosen their own successors, and George S. Philbrick has succeeded C. W. Hackett in Belknap county. For the term commencing June, 1886, Joseph Farnum, of Peterborough, has been appointed successor to D. H. Goodell, and Jason S. Perry, of Rindge, succeeds George K. Harvey.

* Post-office address, Concord.

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STANDING COMMITTEES FOR 1886–87.

The secretary being *ex-officio* a member of each.

Finance. — Messrs. Humphrey and Parker.
Horses. — Messrs. Whittemore and Farnum.
Neat Cattle. — Messrs. Perry and Carr.
Sheep, Swine, and Poultry. — Messrs. Lyman and Mason.
The Dairy. — Messrs. Parker and Whittemore.
Diseases of Animals. — Messrs. Mason and Philbrick.
Farm Machinery. — Messrs. DeMeritte and Humphrey.
Farm Products. — Messrs. Farnum and DeMeritte.
Experimental Work. — Messrs. Philbrick and Lyman.
Miscellaneous Matters. — Messrs. Carr and Perry.

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AGRICULTURAL ROOMS,
CONCORD, N. H., May 31, 1886.

To His Excellency the Governor:

It is required by statute authority to place the report of the Board of Agriculture in the hands of the public printer by the first day of May, annually. The fifteenth volume, now presented, is only technically prepared at this date. Though the secretary has the outlines of the report in readiness, there is much detail of farm-work, experiments, trials of new machinery, and most of the studied and valuable papers that will occupy these pages yet to be collected. They are in the hands, if not in the heads, of their authors and are secured for the public only through the repeated and persistent efforts of the secretary. There are now in preparation, soon to be perfected, a number of papers whose matter has been discussed at the winter meetings, and which will be presented in a far better form than they would have been, except under the direction of their authors; others still, on practical farm topics, or those closely allied to our agricultural interests, will find a welcome place on these pages and at the farmers' homes.

The delay which has thus been caused in the printing will admit much fresh material, and perhaps lead the reader to charge the secretary with admitting articles not in chronological accord with the date of the preface. They will, however, bear the evidence of a more careful preparation and be more acceptable to the people in whose interests they are prepared.

JAMES O. ADAMS, *Secretary.*

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REPORT.

THE WORK OF THE YEAR.

Our working year commences with the opening of the harvest, or rather more definitely and earnestly, with the last gathering in of the year.

The first annual duty has been a meeting of the members for free intercourse regarding the work required in the several counties, and the consideration of topics most important and best adapted to the different sections of the state.

The annual meeting for the year covered by this report was held the first of September, 1885, at the Manchester House, Manchester, at the time of the annual state fair.

The board was largely represented, and favorable reports were made from the several counties. Dr. Hackett, of Belknap county, whose health has prevented him from doing the work he is well qualified to execute, was present and expressed a deep interest in the proceedings, but took occasion to say that he could no longer co-operate with his fellows in the work, and that he had notified the executive of a desire to be relieved from further service. It will be perceived that his successor was appointed a few weeks later. No new members were accredited at this meeting, but two of the oldest and original members, Mr. Humphrey and Dr. Mason, one being seventy-eight years old, and the other close approaching seventy, brought evidence of reappointment by the governor and council, to the gratification of every member present.

Mr. Humphrey was unanimously re-elected chairman, and Mr. Adams was re-elected secretary. The appointment of

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standing committees to act with the secretary on various matters was referred to the chairman and secretary, and when fully completed they were organized as reported on a preceding page of this volume.

A variety of topics was brought before the board and carefully considered. It was reported that those communities where meetings of the board had been held were, with scarce an exception, repeatedly giving invitations to "come again," guaranteeing full attendance, while those towns which had never been visited manifested but little interest. It was decided that such towns needed all the more attention with the view to creating more earnestness in the work of the farm. It was generally admitted that the course adopted in Coos county, with a wide territory and a sparse population, of going with a small force to the small towns, and those remote from centers of trades, was the most profitable. It has been customary to hold from four to six meetings each year in such places as would give an audience, even though small. In a single week meetings have been held at Stark, Milan, Berlin, Gorham, Shelburne, Randolph, Jefferson, and Whitefield; and at another time at Northumberland, Groveton, Colebrook, Stewartstown, Clarksville, and Errol; this plan was approved and recommended by the board. It was deemed advisable to pass by the large villages, except on special occasions, but by no means to neglect any small farming town which would open its town hall, church, or schoolhouse to the board.

The present management of fairs was considered, and while the board possesses no authority to direct, the members thought it their duty and right to lend their aid in supporting well conducted exhibitions. It was admitted that a majority of these annual shows had degenerated, and were too often mere "horse races," locations for "pools," liquor selling, and fortune wheels, yet it was maintained that some yet sustained good order and were free from immoral influences. Among those specified as worthy of patronage, the Upper Coos seemed to be without a rival. The Kearsarge was also commended, and the East Canaan fair. Those held by most of the towns, recently, are generally well conducted. Sullivan county has taken the lead for a few years in sustaining good fairs at Newport, Grantham,

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Acworth, and other places. The former fairs at Derry and Chester, Center Harbor and Moultonborough, have had a good influence, as have also those at Canterbury, Salisbury, and other places we might name.

The board indorse those which have been under moral restraint, such as have been conducted by farmers and mechanics, but condemn such as have been run in the interest of the sportsman, the politician, and the "dead beat."

They also, as they have usually done, indorsed the principles of the grange, and expressed a desire for mutual co-operation in every work that will aid the tiller of the soil.

The usual number of meetings has been held during the year, and they have been well attended. These have been freely reported in the weekly journals, and have anticipated our official record at the farmers' homes. And here we may with great propriety acknowledge the valuable co-operation of the newspaper press throughout the state.

We purpose to omit reports of these meetings, because the occasion which produced them has long gone by, and we believe we can occupy these pages with fresher and more important matters.

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SPECIAL PAPERS.

CONSIDERED AT MEETINGS OF THE BOARD.

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GEOLOGICAL DEVELOPMENT.

BY JUSTIN E. BURBANK.

THE territory of our state is not extensive in comparison with that of many others. A little over nine thousand square miles is all that New Hampshire can call her own. This does not allow her the privilege of boasting of her imperial domain. Her length is one hundred and eighty miles, her average width fifty-two miles, covering a little more than two and one half degrees of latitude, and less than a degree of longitude.

Within these somewhat narrow limits is included a great variety of surfaces and of soils, and much diversity in respect to climate and altitude. The elevation of the different localities within the boundaries of the state rises from the level of the sea to six thousand two hundred and ninety-three feet. Almost every foot of this variation is represented by the height of some particular area of land.

In climatology, also, great differences manifest themselves. From the highest mean annual temperature of 48° Fahrenheit, the mercury sinks in the coldest region to 25° for the yearly average. Mountain and seashore are ours without passing any state line. The roar of the Atlantic and the raging tempest on the top of Mount Washington may both be experienced by the traveler on the same day without crossing over any foreign soil. No other state in our Union, probably nowhere in the world, contains so great diversity in so little space.

At first we are inclined to group all these conditions together, and represent them as springing out of the physical geography of

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the state. But the physical geography of any specified territory rests upon its geology as a foundation.

Geological development in its final fixed result determines the main features of the geography of a country. Geological influences were at work far back in the history of material things, and carved out the continents as they now exist, fixed the bounds of ocean at its present shore, dotted the sea with islands, and adorned the landscape with silver streams that conduct along their highways the returning waters to their natural bed. We cannot trace matter back to its original creation, and see it in its primeval form launched into existence. Human knowledge has a limit put upon it. Clouds of eternal mystery rest upon some things, and it is vain for us in our blindness to endeavor to remove or to penetrate them.

The study of the scientific geologist, nevertheless, devoted to the hardened surface of the earth, is able to infer with some degree of certainty, that there was a period when what we call the solid rock was in a state of fusion, or at least in a plastic condition, through the influence of heat, and that then it took the shape which it now presents to us, and cooled into its apparently unchangeable form. Further back than this, science furnishes no guide, and conjecture is essentially of no value in such a field.

From the shape our rock-ribbed state has assumed, we may infer some of the laws of the forces which raised its surface from out the unseen depths. The power that brought the White Mountains from below would appear to have been applied in a lateral direction, and, subsequently, the ridges raised by this force were subjected to some mighty propelling influence, acting in a direction nearly at right angles with the first. We cannot determine whether it was steam or expanding gases, or mighty solid bodies coming into collision, and in their mutual crash raising some masses and depressing others, breaking some accumulations of matter and driving others together. All such conflicts were pre-historic, and probably anterior to animal or vegetable life. The varied action of these spent forces has left as a legacy for our contemplation and study a surface geology of as much interest as any upon the face of the globe.

In the application of geology, as far as it has become a trust-

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worthy science, the leader in the late state survey has accomplished a work of no small value to the student who is interested in acquiring knowledge, and to the native of our soil, who loves the place of his birth, and who desires to thoroughly understand all that appertains to it, because it is his own home.

New Hampshire is geologically as old as any land on this continent. It belongs to what is styled the Eozoic period, the earliest of the four great periods into which the geological era is divided. Though the term, through its etymology, indicates the dawn of life, the lower division of the Laurentian section is azoic, or without life. This embraces the porphyritic gneiss that is so common in the elevated ridge that divides the valley of the Connecticut from that of the Merrimack.

This land, the first to appear within our limits, rose out of the wide-spreading ocean in the shape of islands, about thirty in number, of a variety of sizes and forms. The largest was somewhat irregular in its outline, and reached from Groton, on the north, to Jaffrey, in the south. In its widest portion, it extended from Hopkinton, on the east side, to Washington, on the west. The northern and southern portions were much narrower, decreasing each to nearly a point.

The most easterly example of this porphyritic gneiss formation was, at the commencement of this primitive period, a very limited area in the town of Seabrook, touching the Atlantic Ocean, bordering on the state line, where, in its sublime solitude, it looked forth upon the waste of waters and beheld nothing but desolation in the midst of the billowy sea, the nearest land being another small island in what is now the town of Pelham. The most northern land was in the town of Whitefield. The White Mountains, except a small portion in the town of Franconia, do not appear.

The highest summit reaches an altitude of 4,300 feet. In the Groton and Jaffrey area, the greatest elevation is seen in Mount Lovewell, 2,487 feet, and Mount Sunapee, 2,683. This area, at its western limit, coincides mainly with the dividing elevation between the valley of the Connecticut and that of the Merrimack.

The above sketch shows the dry land of New Hampshire at the close of the Laurentian period. The succeeding Montalban

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period of the Eozoic era presents an addition of a much larger area to the extent of the state. At the close of this period nearly two thirds of it were out of water. The eastern boundary was a line between Dover and Lake Umbagog. The southern boundary was a line between Hinsdale and Brookline. The southeast limit of the development of this period and the preceding one was a nearly straight line connecting Brookline and Dover. The western limit was a line nearly parallel with the Connecticut river, distant from it about the width of one line of towns, and reaching from the Massachusetts boundary to Haverhill. The northwestern limit was a nearly straight line across the state diagonally from Haverhill to Lake Umbagog.

The Montalban formation seems to be joined to the Laurentian as to a nucleus. It includes several different varieties of the gneiss rocks, as the Bethlehem group, the lake gneiss formation, the White Mountain and the Franconia groups. Within this last are included the granites of Concord, Plymouth, and many other towns in the state, which are very valuable for purposes of architecture and of art. The entire area gives abundant proof of metamorphic action.

The study of these rocks in all their rich variety gives rise to many an interesting problem, which the geologist must study carefully in order to arrive at a satisfactory solution.

The Labrador, the next period, is marked by the breaking forth of liquid masses of molten matter, produced by subterranean heat, and ejected, without doubt, in consequence of some depression in the surrounding solid masses of the preceding period. This melted matter, on cooling, constituted the granite and syenite that include a part of the White Mountains and an extensive range of territory between Franconia and Conway. The Labrador period, while it produced such important changes, did not add largely to the extent of the land of New Hampshire.

The period following this was the Huronian, and without doubt the dry land of the state assumed during its continuance a settled, solid condition, and may have been covered with a light clothing of green vegetation. It was the era of the deposit of the precious metals of New Hampshire, and of some other minerals.

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The close of this period gave us, rising upon the surface of the ocean, an area of varying width, extending from Cambridge, on the north, west to the state line, and along the Connecticut river to Orford, on the south. The first division of the period was that of the deposition of copper and iron, with a slight admixture of gold particles. Then followed the formation of a fine siliceous mud, with soapstone, dolomite, and serpentine. Afterwards appeared a conglomerate of quartz pebbles, with some gold mechanically intermingled.

After the Huronian period, which made visible, with what had before appeared, nearly the whole surface of the state, followed an era which deposited upon a formation long before brought into existence what was designated the schists of Rockingham, the Merrimack group, auriferous clay, slate, and other rocks. This could only have been accomplished by the subsidence of what had been previously above the waters.

The Rockingham schist covered mostly Rockingham, Strafford, and Belknap counties, and portions of adjoining counties. West of the Merrimack river there are some limited areas that are supposed to belong to the same group. A narrow range occupying the western limit of the porphyritic gneiss of the Laurentian period is covered with this schist. It extends from Lake Sunapee down through Newbury, Washington, Marlow, Gilsum, and Sullivan. Between Landaff and Keene is an extensive deposit of andalusite mica schist, which includes Moosilauke and Mount Carr. Monadnock and the Kearsarge ragged area are isolated masses of the same rock.

The deposit during the Connecticut-Coos period lies north of Dummer and Cambridge, and embraces the width of the state, which is narrow at that latitude. The era may be divided into three sections: the first, when the mountain masses of silica were deposited; the second, when the materials essential to hornblende and mica schist settled to their permanent position; third, when the limestone rock in its primary elements took form and place. About the same epoch, the clay slate formations along almost the entire length of the Connecticut valley were deposited. There are other small areas scattered in the state, especially in the White Mountains, that seem to

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belong to the Coos group. The period was terminated by eruptions of syenitic granite.

There do not appear to have been any geological changes for a long cycle of time after the close of the Coos and schist periods. There are no signs of a continued submergence of the Connecticut valley after the deposition of the Coos rocks. The next deposit was at the close of the Silurian period.

This is called the Helderberg period, from the resemblance of the fossils found in its strata to those of the Helderberg Mountains in New York. The Helderberg Ocean covered the same territory, with that just described, west of the Montalban ridge. The rocks of the period are found in Hanover, Lyman, Lisbon, Littleton, and other towns. Most of them include crinoid and coralline limestones.

The Connecticut valley was apparently covered deeply by this ocean. The land of the state was probably covered with vegetation in rich variety. There were deposited in this period sandstone, coralline limestone, together with slate schist, and conglomerate, each of great thickness, the latter being made up of pebbles from the Huronian and Atlantic rocks, and some of the Coos limestones.

During several succeeding geological periods, New Hampshire appeared above the bosom of the ocean and, perhaps, extended to the east of the Isles of Shoals. Nothing belonging to these periods is visible in the state. They left no deposit and exerted no influence upon the area of the state, as far as can be seen now.

Vegetable and animal life, without doubt, flourished within its limits, and a warm, temperate climate prevailed. At the close of the Tertiary period, a much lower temperature began to exert an influence; the snow and ice formed failed to melt, and glaciers of vast extent and great depth were everywhere to be found. For a period of immense length the state was covered with these glaciers, and the climate corresponded in general with that which prevails now in Greenland.

Numerous scorings on the rocks in every locality show that there was a movement of the ice in a southerly direction. In the whole of Coos county, in the White Mountains, and among the higher peaks along the watershed between the Connecticut and

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Merrimack rivers, the course taken by these mountains of ice was southeasterly. The highest marks of their course that can be discovered are 5,200 feet above the level of the sea; but pebbles transported by them have been discovered 600 feet higher, on the north slope of Mount Washington. The summit of this mountain seems to be the only part of the state that has not been subjected to glacial action. Grooves, running from the base to the top of the mountains on the northerly side, show the course taken by the ice; but the southeasterly slopes present only slight indications of its passage. The ice south of the White Mountains and east of the Connecticut river valley, for the most part, pursued a southerly course.

The highest mountains of this region must have appeared as islands in this sea of ice. In the Connecticut valley, south of Columbia, the ice moved south, a few degrees to the west, according to the course of the river. A set of striæ shows that glaciers moved down the valley of Baker's river to Plymouth, and thence easterly and southeasterly across the state, into Maine. There are similar indications along the line of the Northern Railroad, from Grafton to Andover, and down the valley of the Blackwater.

The effect of local glaciers has been observed in different parts of the state. The terraces along the Connecticut and Merrimack rivers demonstrate the height of the water in these streams, showing the gradual slope of the higher banks from the sources of the rivers to their mouths, corresponding to their fall as they approach nearer to the ocean, and thus furnish proof of the gradual melting and withdrawal of the ice from New Hampshire.

During the glacial period, the land was submerged to the depth of two hundred feet, as we learn from the presence of maritime plants. Since that period, the remains of a few southern plants indicate a long era when the climate was milder than it is now. The discovery of colonies of marine animals belonging to a more southern latitude is a proof of the same thing, and there is evidence that this warm period extended down to the time when the aborigines inhabited the region. This evidence is found in piles of shells of oysters, natives of a warmer clime, that are found on the northerly New England coast, these shell-fish having un-

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doubtedly served as food for the human inhabitants of the neighborhood where they have been found.

Such is the outline, brief and imperfect as it is, of the geology of our state, and how much abounding in interest scarcely needs to be asserted. It is perfectly clear that it has exerted and still exerts a marked influence upon the people of the present geological era as to their character and as to their pursuits, and upon the physical geography of the state, determining the altitude of its various localities, the shape of its mountains, the course of its rivers, the nature of soil that prevails along their valleys, the basins that hold its lakes and ponds of unsurpassed beauty, and even to a large extent the course of its railroads that are its thoroughfares for travel and for the transportation of goods.

The altitude of the state, taken in the average, is 1,400 feet. Of course this must affect materially the climate and the character of the atmosphere. The altitude is a direct result of the geological development. This gave us mountains and valleys and level plains. Altitude determines what breezes shall blow, what air we shall breathe, whether that which is laden with deadly miasma, springing from the corruption of vegetable and other matter and bearing to us destructive malarial disease, or whether we shall breathe that which has been made pure by the commingling of various currents from higher and more salubrious regions, and improved by the effect of condensation and rain-fall, so that the noxious elements have been scattered and rendered harmless by contact with what has in effect neutralized them or diffused them. The atmosphere we inhale must be uniformly at a temperature not very high, or it debilitates and corrupts the blood. The state of New Hampshire is almost absolutely free from a malarial atmosphere and that class of diseases which are nourished by it. The period of excessive heat is so short that our air is nearly free from any danger from that source. The lowest altitude of the state is cooled by the action of the sea breezes that come from the ocean lying along our southeastern border and furnishing a succession of beaches that are most agreeable places of summer resort. The area of low land is so small that its conditions are modified by contiguous regions that are more elevated. The degree of cold is not excessive, except in certain regions of not

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extensive area, which for that very reason are largely frequented during the hot months.

The highest of our mountains are pleasure resorts in the heat of the summer and have a sanitary value that is not fully appreciated. We are able to furnish more places of summer resort than any other state of equal extent of territory. From the White Mountains to the seashore, we have every gradation of altitude, and furnish everywhere a variety of retreats for those who seek for the recovery of health, as well as relaxation from the burdensome cares of business. Nature, to an unusual degree, has thus favored us through our geological development.

The somewhat cold breezes of winter are not without their favorable tonic effect upon the human constitution, if proper care is taken against too great exposure in the open air, and too high a temperature in close rooms which vitiate and render unfit for breathing the atmosphere inclosed within their narrrow limits. By neglecting these two precautions we sometimes lose nearly all the benefits which might be derived from our fine winter climate.

The effect of the geology of New Hampshire upon the cultivation of the taste is of no small value. The scenery which it gives us is beautiful and frequently sublime. There is no deadly, depressing monotony about it. It varies while it instructs and elevates. While our highest peaks exalt and purify the imagination, invigorate and ennoble its conceptions, giving ideas that struggle towards the infinite, lower altitudes abound in views of surpassing beauty that also develop and cultivate, and render subtile and discriminating the æsthetic faculty.

The presence of beautiful and sublime objects in nature allures those who possess any gifts in that direction to copy in art that which has captivated their sensibilities. Hence, the sublime scenery of the region of lofty mountains and softer landscape appears upon the canvas of the painter, and his reproduction of what nature has done stimulates and inspires the genius of those who have not studied the great original. Nature, within the bounds of our own state, is ever instructing by lessons of more power than any master spirit in the realm of painting or statuary can give.

Though there is not a distinct moral or spiritual power to

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nature, in her most exalted manifestations there is something that is allied to it, and by an indefinite attraction would bring into harmony with that which is higher and nobler and better. The influences of climate and scenery in some parts of the world are depressing to every higher aspiration, and seem hardly to possess any agreement with an elevated, moral purpose. Happily, there are few such influences in the state where we dwell. The geology that determined the scenery that surrounds us forbade their existence, and commanded us to seek that which was lofty and noble and generous.

The geology of the state has, to a great extent, determined the manufactures that are a chief source of wealth to those who carry them on. The mountains furnish the source of the rivers; the height of the mountains determines the descent of the rivers towards the ocean level. The water power depends upon this descent of the streams to their great receiver. Manufactures, though the etymology of the word signifies that which is done by the power of the hand, are very extensively and more profitably carried on by the power of the water that is ever gravitating with a rush towards the point it can reach nearest the center of the earth.

The Connecticut that rises far to the north, and almost within the province of Quebec, winding its way with short curves southerly, to the sea, furnishes more power for useful manufactures than has been yet used. An undeveloped capacity remains stored up in its waters, but the time will come when all its energy will be put to some valuable use. The hum of machinery and the tread of a busy population will be heard more than now upon its pleasant banks, and wealth and culture will spring out of this application of its waters.

The Ammonoosuc, one of its tributaries, supplies the power of various enterprises at Littleton, Lisbon, and Bath.

The Ashuelot is the creator of many industries that flourish along its banks.

The Androscoggin, rising in Lake Umbagog, and gliding along the eastern portion of Coos county till it passes into the state of Maine, supports an active business of much value at Berlin and Shelburne and other points.

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Salmon Falls river runs its brief course, emptying into Piscataqua river and bay, but is by no means a useless adjunct to Rollinsford and Great Falls.

But the Merrimack is in the highest degree the parent of manufacturing industry and wealth. Its descent has given facility to the growth of large cities upon its banks. Manchester sprang into being because of falls in this river, and because enterprising, far-seeing men could form a conception of what was possible, and what being possible, they determined should be real. Therefore, a city combining wealth and a population of enterprise and refinement adorns the sandy banks of the Merrimack river, in the neighborhood of Amoskeag Falls.

And below, on the same river, though deriving its power from the Nashua, a tributary of the former, rises the goodly city of Nashua, older than Manchester, and yet beginning its prosperous career within the memory of many persons now living. Such tributaries as the Pemigewasset, the Winnipesaukee, flowing from the north, the Contoocook, flowing from the south, almost at the Massachusetts line, support on their banks busy hives of industry.

There are many smaller streams that cannot be mentioned here, which, in their sum, contribute a large amount to the wealth of the state, and furnish a field for the industry and enterprise of the people which cannot be estimated with exactness. Exeter river also furnishes facilities for extensive manufactures.

The last census of the state returns the number of separate establishments as 3,181; the capital invested as $51,112,263; average number of males employed above 16 years of age, 29,356; average number of females employed above 15 years of age, 16,184; average number of children and youth, 3,291; total number, 48,331; total amount paid in wages during the year, $14,814,793; value of materials used, $43,552,462; value of products, $73,978,028. Some of the statistics of specific cotton manufactures are as follows: Capital invested, $19,877,084; number of spindles, 944,053; number of looms, 24,299; operatives employed, 16,529; cotton consumed, bales, 157,673; cotton consumed, pounds, 76,386,499; value of cotton consumed, $8,629,063; wages of operatives, $4,290,960; total value of materials used, $10,146,904; value of products, $17,953,403.

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The importance of this branch of industry is manifest at once, and the relation of the geology of the state to its existence and prosperity is also manifest. The rivers of the state are, for the most part, the operating power in these enterprises. The geological development of the long ages not only furnished the channels wherein flow the streams of water, but put into action the influences that supply the water running along the courses created by the geological deposition of the rocks. The prime sources of the Merrimack are in the White Mountains and the lake region.

The mountains draw from the clouds their moisture as they pass over their elevated summits, and hold it by their forests and by the mossy covering of their sides, their glens and deep ravines, so that it does not speedily flow away in useless and damaging freshets, but gradually runs towards the region of its profitable employment. Lake Winnipesaukee is a great reservoir of water, where is stored the power to be used when most needed for the propelling of machinery to the great advantage of capitalists, who have their money invested, and of labor that must needs have a field of operation, or fail of profit and lose its unused capacity. Geology has also formed many other basins of smaller extent for saving the water for the exigencies when it will be most needed. The ponds that supply the tributaries of the larger Merrimack and other streams are many of them most useful as places for the accumulation of surplus water, which is sure to be needed after the heat and drouth of summer have cut off the other supplies of moisture. The capacity of these natural reservoirs is commonly largely increased by means of dams constructed at their outlets, and opportunities are abundant for the construction of artificial reservoirs.

The forests of our mountain regions check the action of the sun's rays upon the accumulated snows, so as to prevent their rapid melting and flow to the ocean bed, carrying, as sometimes happens, ruin in their course. In these many ways, geology becomes the servant of the people, aiding them in what is greatly essential to their prosperity and happiness.

Notwithstanding all that has been done in applying the power of the water system of the state to the uses of industry, much of this power is still latent, that is, it is unused. It is said that there

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is more water power in the Merrimack than in all the rivers of France, a level country whose streams are relatively sluggish and to that extent without the power of driving machinery. At Sewall's Falls, on the Merrimack, in the city of Concord, within three miles of the state house, is a descent in the bed of the river which creates a power sufficient to keep in operation the manufacturing enterprises of a city of moderate size. Capital will doubtless find, before long, a permanent and safe investment here.

Allusion has already been made to New Hampshire as a general summer resort and sanitarium, containing more pleasant retreats than any other state of its size. Without any great degree of investigation, it becomes manifest that this is the fruit of its geological development. It is also obvious as a source of much pecuniary profit to those who possess the real estate including the temporary homes of those who come from abroad.

The relation of geology to agriculture is direct and important. All soil must spring from the rocks. The field of this department of industry was originally a barren area of rock that rose out of the waters through the effect of an internal force, or from a subsidence of the surrounding ocean. In process of time, the action of the atmosphere and the rain, aided by the frost, broke up and pulverized the masses which seemed at first so unyielding. Reduced to this condition, the rocks form the greater part of the soil which we denominate earth, though a part arises from the decay of vegetable matter, which goes into the soil to return again and form new vegetable products.

The nature and value of the soil for agricultural purposes must be largely determined by the geological formation from which it springs. All the inorganic elements, which are the food of plants, are the result of the dissolution of the material that geological forces have brought to a state which is solid and permanent to most influences, except those of the atmosphere, rain, and frost. These operate slowly and surely to work out their appropriate results, and give us a soil containing the original elements of the rock.

Calcareous soils, gneissic, including granitic, and slaty soils comprise the great divisions which are a direct consequence of

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the geological influences of former eras. The calcareous rock of the Connecticut valley at Colebrook and Claremont has impressed upon it those qualities of fertility that are not everywhere manifest within the narrow limits of the state.

Slaty soils have a good degree of fertility, and are exhibited on the Connecticut river and in Rockingham county. There are the schistose rocks, that are allied to the slaty formations, and frequently border on them, and on their decomposition form a warm and somewhat rich soil. Mica schists, when exposed to the atmosphere, often exhibit a very rapid decomposition, the pulverized matter assuming a yellow color.

A large portion of the state is underlaid by gneiss. This, in the material of its composition, resembles granite. It contains feldspar, mica, and quartz. The soil produced from it is usually better than that coming from granite. Potash, the soluble element of gneiss, is found in large quantity in feldspar. The carbonic acid of the atmosphere combines with rain-water and, acting on granitic and gneissic rocks, has a tendency to decompose them, and thus a large per cent of potash is set free to enter into the composition of soils, furnishing a needed element for the growth of vegetation. Alumina, also a valuable element of the soil, constitutes about twelve per cent of the weight of feldspar. Four equivalents of silica and three of oxygen are the other elements that enter into the composition of this mineral. The other materials that unite with these varieties of rock are mainly silicon. The decomposition of them would result in large quantities of sand, as well as of those substances mentioned. The feldspar of granite is in less proportion than that of the different kinds of gneiss.

Calcareous soils are generally very productive of wheat, the prince among the cereals. By the decomposition of these rocks, many small moluscous animals obtain the materials for their shells. The beds of marl at the bottom of ponds, in deposits several feet thick, from which nearly pure lime can be obtained, as well as a fertilizer all ready for application to the land, arise from this source. These beds add new value to the calcareous regions. The disintegration, which has made the surface of the state what it is, was, in its effect, much more intense in the by-gone ages of

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geological time than now. Before the Carboniferous period, there was more carbonic acid in the atmosphere than at present. This would be introduced through the crevices by means of rain-water, and would also act upon the external surfaces by enveloping them.

One result was the decomposition of the rocks containing feldspar. From this decomposition came beds of kaolin clays, and gravelly heaps of the residua, while the potash sometimes flowed off in the streams. Rain, rivers, glaciers, icebergs, ocean, landslides, and the great northern drift, accomplished a mighty work in removing rocks and soils, and in mingling them together. The transportation of calcareous rock has, in some instances, improved the character of the soil.

It is believed that erosions anterior to the glacial period removed as much as fourteen hundred feet in depth from the entire surface of the state. It can be seen what little value the land would have for agricultural purposes, were its average level at the height of 2,800 feet. Thus have geological forces wrought for man in giving him a habitable abode and appropriate surroundings. Geological development has, from the dawn of its action, exerted its influence upon the agricultural interests of the state, or, more truly, upon the foundation on which it rests. The different varieties of soil within our bounds depend for their differences mainly on the cycles of geological time that defy our calculation.

The knowledge of geology is the knowledge of soils. The knowledge of soils is necessary to, and will extensively determine, our knowledge of fertilizers, as the fertilizer furnishes what the soil wants for the growth of the crop.

The inorganic chemical elements that enter into the formation of vegetable organizations are derived from the rocks, and are these: Oxygen, sulphur, phosphorus, carbon, silicon, potassium, sodium, calcium, aluminum, magnesium, iron, and manganese. The decomposition of rocks containing a large amount of silicon produces a porous, sandy soil. Where alumina is predominant, the result is a thick, clayey soil that hardens in the sun, and fails to properly nourish the plant. In like manner fail the excessively sandy localities. In them, the earth does not retain the moisture

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that reaches it from its various sources, and the want of water leaves vegetation to suffer.

It is when the two are properly joined together that a favorable condition is presented for the development of vegetable growth. Everything that enters the plant must enter it in a state of solution. The pores of every living thing that grows out of the earth are the avenues by which its supporting sap carries nutrition to its various parts. Everything must enter and pass along these in a fluid state and become incorporated, by the action of the vital forces, with the living fibre of the plant. All subtances, organic and inorganic, must follow the conditions of this law.

Water is the medium of communication between the mineral and the vegetable kingdoms. This element itself forms a large part of the substance of all plants, but performs a service as important in carrying to its destination all other kinds of nourishment. The magnesia, the iron, the alumina, the silicon, the potassium, the phosphoric acid, the carbonic acid, must all make use of water as a servant and must enter into a combination with it. When a tree loses its moisture, it is deprived of its sap and of its fibre at the same time. Its death is made certain.

The most important service of silicates and of alumina is to furnish a soil that shall be sufficiently porous to enable the air to reach the roots of all growing crops, and to hold in solution the water that is needed for all purposes of securing their development.

In addition to determining the character of the soil and making known the requisites for its improvement, geology is the science that often reveals the fertilizers that are needed to invigorate the exhausted fields and supply what the geological development has not afforded. The geologist is sometimes able to point out deposits of phosphates, and show what rocks contain carbonate of lime, or discover sulphate of lime, marl beds, or decomposed fossil shells. Geology is a science that stands in close local relation with agriculture, and, in conjunction with chemistry, may do much to assist it in accomplishing its purpose. Agriculture, though a practical art, involves many scientific principles, and must not disdain assistance from any source, whether within or without its own specific field. Scarcely anything is ab-

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solutely independent and entirely by itself. All science joins hands, and every section helps the rest. There is no exception in respect to agriculture.

New Hampshire, though only of a very small area, has an industry in the line of cultivating the earth that is honorable to the capacity and probity of its inhabitants, and productive of comfort and a fair degree of wealth. The statistics, as given by the last census report, show the annual production of useful crops to be as follows: Hay, 583,069 tons; hops, 23,955 pounds; orchard products, in value, $972,291; potatoes, 3,358,828 bushels; wool, 1,060,589 pounds; milk, 5,739,128 gallons; butter, 7,247,272 pounds; cheese, 807,076. The following are the cereal products of the 3,460 acres devoted to their culture: Barley, 77,877 bushels; buckwheat, 94,090 bushels; Indian corn, 1,350,248 bushels; rye, 34,638 bushels; wheat, 169,316 bushels. The whole number of farms is 32,181; improved land, 2,308,112 acres; value of land, fences, and buildings, $75,834,389; value of farming implements, $3,069,244; value of live stock, $9,812,064; cost of building and repairing fences, $334,410; cost of fertilizers purchased in 1879, $165,393; estimated value of all farm products, $13,474,330. The increase in the number of farms from 1870 to 1880 was 9 per cent. The total area of settlement was 8,705 square miles. The total population of the state in 1880 was 346,991.

The people, with a good degree of contentment, cultivate the fertile valley and the less productive plain, while the hills give pasturage to a multitude of flocks and herds.

The relation of geology to all mining enterprise is direct and manifest. Mining is obtaining treasures from the bowels of the earth. All precious metals and all others are the deposit of geological agency. They came from the waters that reigned at first, and contained, through the wisdom and skill of the Creator, all the elements of things useful and precious, though they may have obtained these elements from some other source. In our own state, though less abounding in mineral wealth than some others, we are able to survey certain not extensive areas that contain beneath their surfaces more than simply the elements of vegetable growth, and are of more value as productive of mineral than

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agricultural riches. Iron of the best quality has been found in Franconia, and mining there has been in operation.

In the Ammonoosuc gold field, gold has been discovered in sufficient quantities to justify mining operations. All our industries are the direct result of the working of that geology which has distinguished our state as an area of much interest and which carries us back, in time, untold centuries, and bids us await the coming era, which we suppose will be only the continuation of the present, with confidence in the all-ruling Power to whom a thousand years are as one day, and one day as a thousand years.

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HOMES AND FOODS.

BY PROF. VICTOR C. VAUGHAN, M. D., OF THE UNIVERSITY OF MICHIGAN.*

BUILDING A HOME.

LOCATION.

THE location of the home of the workingman is often determined by considerations over which he has no control. Cost of land and distance from place of labor must influence the selection. If possible, however, the house should not be located in a low, damp place, or on made earth. In cities, many low tracts, and even the beds of small streams, marshes, and lakes are filled in with general refuse, such as street sweepings, back-yard rubbish, ashes, and garbage. Such soil, unless thoroughly underdrained, must be unfit for the location of habitations. It is damp, and will for years be filled with the products of decomposition, arising from the putrefaction of the garbage deposited there. Houses built in such locations must be damp, musty, and unhealthful. The inmates of a house built in such a place are likely to suffer from malaria, bilious fever, and rheumatism, even if they do not fall victims to the more dreaded diseases, typhoid fever and consumption. The house should also be far from

* This paper was presented to the American Public Health Association in competition for a prize offered for essays of various subjects, by Mr. Henry Lomb, of Rochester, N. Y. It received the award on the subject of "Healthy Homes and Foods for the Working Classes." We have been not only permitted but requested to give the farmers of the state the benefit of its suggestions, all reserved rights having been waived for the purpose by the secretary of that association, Dr. Irving A. Watson, who is also the secretary of the state board of health.

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marshes and other low lands whose surface is covered with water in the spring and early summer, and then exposed later. Such situations are likely to be malarious. Neither should the home be located near manufacturing establishments which usually have garbage about them, such as breweries, tanneries, glucose factories, rendering houses, and oil refineries.

The site should be one which is naturally well drained. The slope of the land should be from the house. Extra precaution must be taken when it becomes necessary to build at the foot of a hill which is covered with houses from which the surface water and underground drainage flows toward the home. The location of neighbors' outhouses, with reference to the proposed home, should also be taken into consideration. While an intelligent man will not neglect the sanitary condition of his own premises, his neighbor's cesspool or privy vault may drain into his well and poison his drinking-water. Have the house upon a place high enough, and as dry as possible. Avoid, whenever practicable, narrow streets, which are devoid of sufficient sunlight and pure air.

The best soils upon which to build are gravel, marl, and limestone, for in these the drainage is likely to be better than in others.

A due amount of shade around the home renders it more healthy, but the shade should not be dense enough, or close enough to the house, to obstruct the air and light.

THE CELLAR.

Every dwelling-house, even that which has but one room in it, should either have a cellar, or should be raised sufficiently high from the ground to allow a free supply of air under it. The walls of the cellar should be perfectly water and air tight. It is better, in making the excavation, to remove the earth a foot, on all sides, farther than the line on which the outside of the wall will stand; then, after the walls have been built, pack the space with clay or gravel. In this way, the walls of the cellar are more likely to be kept dry. If built of brick, the walls should be hollow, consisting of a thin outer wall, two or three inches from the main wall. The two are firmly held together by occasionally

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placing a brick across from one to the other as the walls are being built. Unless this is done, moisture will pass through a brick wall, it matters not how thick it may be.

The cellar floor should be of concrete, about six inches thick, and covered with Portland cement or asphalt. If the soil be very damp, tiling should be placed under the cellar floor, and carried out beneath the wall to a larger tile, which passes around the house and leads off into some suitable receptacle.

It is absolutely essential to a healthy house that its cellar should be free from dampness and ground air. In order to secure these requisites, the walls and floor of the cellar must be well built.

The cellar should be well supplied with light by having windows above ground, or by sunken areas in front of the windows. The window-sashes should be hung on hinges, so that they may be easily opened when the cellar needs an airing.

If the cellar is to be used for several purposes, as the location of the heating apparatus and the storage of fuel and vegetables, it should be divided into compartments, the temperature of which may be kept at different degrees.

Basement bedrooms are almost universally unhealthy, and should be used only in cases of absolute necessity. It is also best not to have the kitchen in the basement, especially if the room directly above be occupied. If stationary wash-tubs be placed in the basement, they should have metallic or porcelain lining, and the pipes which conduct the refuse water from them should be thoroughly trapped.

THE WALLS.

If built of brick, the walls of the house should be hollow, as described in referring to the walls of the cellar. Furthermore, the plastering should never be placed directly on the brick. The inside of the wall should be "furred," scantling nailed to the furring, and the lathing done as in a frame house. It has been found that a single brick will absorb as much as one pound of water; and if a brick wall be built solid, and the plastering placed directly on the brick, the house will be constantly damp. Many of the older brick houses are constructed in this manner,

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and consequently their interiors always have a damp, musty odor, it matters not how untiring the housekeeper may be in her efforts to have everything sweet and clean.

Even in case of a stone wall, the plastering should not be placed directly on the wall, though stone does not absorb water to any such extent as brick does.

New brick and stone walls are necessarily damp, and for this reason houses built of either should not be occupied until some weeks after the building of the walls. In order for them to dry thoroughly they must be pervious to air, and walls built as recommended above will allow the air to pass through them freely. Plastering does not prevent the air from passing through the walls, but papering does. However, as papering is the most economical way in which walls can be decorated, it will long continue in use. Wall papers containing arsenical colors have been and are still, to some extent, used. Rooms decorated with such papers are not suitable for living-apartments. It is generally supposed that only the green colors contain arsenic, but, in truth, it may be present in paper of any color. The only way, then, by which they may be avoided is by having the selected samples tested. Any intelligent druggist or chemist will make the analysis for a small fee, which should be at the expense of the paper-dealer.

A nice way of finishing inside walls is to paint and then varnish them. The varnish prevents the rubbing off of the paint, and places the walls in such a condition that they may be washed whenever desirable.

THE FLOORS.

Floors should be made tight, so that they may be thoroughly scrubbed with soap and water occasionally. The best floor, from a sanitary view, is one of hard wood, planed smooth, and oiled. It is far better to have a clean, bare floor, than one covered with a filthy carpet. However, where carpets are kept clean, and are occasionally taken up, and the floor scrubbed, there is no objection to their use, and it must be admitted that a clean carpet adds much to the comfort of a room. A cheap straw matting is now made, which can be washed when necessary, and it will not

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retain dust and filth to the extent that woolen carpets do. Such a covering is especially suitable for dining-rooms.

ARRANGEMENT OF ROOMS.

The living-rooms should be on the sunny, airy side of the house. Human beings as well as plants demand sunlight. Too frequently the good housewife shuts out the sunlight for fear it will fade the carpet. As some one has said, "It is far better to have faded carpets than to have faded cheeks." A little saving in the color of the carpet is poor economy when it is secured at the cost of health. Especially should the room occupied by the women and children, who are indoors much of the time, be well supplied with light. If there is to be a long, dark hall or passage-way in the house, let it be on the side upon which the least sunlight falls, and place the living-rooms on the other side.

It is, unfortunately, the fashion to make bedrooms small, in order to have a large sitting-room. Too often the bedroom is a mere recess, scantily supplied with fresh air. It is better to have a smaller sitting-room and a larger bedroom. Even farmers often suffer from diseases which are due to an insufficient supply of pure air. This arises from the fact that for six or seven hours out of every twenty-four they are shut up in small, tight, musty bedrooms, and are compelled to rebreathe the air which they have already once breathed.

If the owner of the house can afford it, at least one bedroom should contain a grate or fireplace, for, with every attention to the laws of health, there will come times when some member of the family will be sick, and the sick-room should be full of cheer. The open fire is cheerful and serves as an excellent ventilator. Pleasant surroundings often aid the doctor's pills and potions in restoring the patient to health.

Of course the number and exact arrangement of the rooms will depend upon the purse of the owner; but a cottage may be built so as to be as healthy as a palace, and, indeed, the advantage is often in favor of the former, as the more complicated finishings and elaborate furnishings of the latter may serve as harbors for dust and filth.

Space may often be saved by doing away with the conven-

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tional long, dark hall, and by having the stairs go up from a sitting-room, or from a smaller vestibule. The long halls are often cold, dark, and dreary. In winter, they are filled with cold draughts, and in summer, they are receptacles of refuse of various kinds, and at all times they are cheerless. They may be necessary in certain houses, but in small homes they are neither ornamental nor pleasant.

It is the ambition of most American housewives to have a parlor, in which the most valuable household ornaments are placed, and which opens only when some honored guest comes. The small boys of the family look upon it as a forbidden territory, and too frequently both fresh air and sunlight are regarded as intruders, and are shut out. The exclusion of the small boy may be all right, but the air and sunlight should not be treated with so much discourtesy. Indeed, they should be considered the most honored guests, and should be welcomed even to a place in the parlor.

Probably the most important room in the house is the kitchen. Before you praise the housekeeping of any woman, visit her kitchen. The parlor may be a beauty, the bed linen may be spotless, the table may be covered with decorated china, but if the kitchen be filthy, all is in vain. But in order that the kitchen may be kept in good condition, its construction must be proper. The floor is best of hard wood or yellow pine; or, if these are too expensive, of selected white pine. They should be kept bare.

At least two windows, one on each side, are desirable. A pantry or shelves for setting aside clean cooking utensils and dishes should be at hand. If the cellar be used for the storage of vegetables, an inside stairway from the kitchen or pantry should lead down into it. The flour-box in the pantry should be so hung that it will close itself. It adds much to the comfort of the cook, and to the cleanliness of the walls and ceiling of the room, if the stove or range be covered by a hood which conducts the vapors arising from the cooking food into a flue in the chimney.

The house should contain a bathroom. In the absence of public water-supply, a force-pump below, a cold-water tank in the attic, and a hot-water tank attached to the kitchen range will furnish the bath-tub. The room should be heated either directly

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or from another room, otherwise it would not be used much in cold weather. The cost of the bathroom and its supply need not be great, while the pleasure and benefit derived from its use will be appreciated.

THE WINDOWS.

If possible, every room should have direct light, and not be dependent on that which is diffused through an adjoining room. The location of the windows should be such as to give the greatest amount of direct sunlight. The windows should extend well towards the ceiling, and should be hung so as to lower from the top, as well as raise from the bottom.

The window shutters or blinds must be hung in such a manner that they are easily opened. In no part of the house should they be kept closed during the day.

HEATING AND VENTILATION.

It would be wholly out of place to attempt here any elaborate discussion of the many methods of heating and ventilating buildings now in use. Only a few practical statements will be made with reference to securing adequate warmth and sufficient fresh air in dwellings.

The most common methods of heating small residences are by the stove, open fire, and hot-air furnaces. The stove is the most economical. The open fire is the most enjoyable and, where it is sufficient, the most healthy, but in the northern states the open fire alone seldom furnishes enough heat during the coldest months. The hot-air furnace may be so constructed as to be a good method, but care must be used in selecting the furnace and arranging for ventilation.

In small houses the heat is generally supplied by stoves. In rooms which are occupied only during a few hours of the day, the wood stove is sufficient, and, indeed, has certain advantages. The room can be quickly heated, and when left, the fire soon dies out, thus saving fuel. But where the room is constantly occupied, coal is a more suitable fuel than wood. The temperature is more even, and the fire burns more slowly. The relative cost of these fuels varies in different sections.

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The coal stove should have no loose joints through which gases can escape. The mica doors should be kept in repair, and the flue must not be allowed to clog. The principal gases given off from burning coal are carbonic acid gas, carbonic oxide, and sulphurous oxides. The carbonic oxide is poisonous when inhaled in any quantity. It produces a sensation in the head similar to that which would be caused by a tight band, and in larger amounts it renders a person insensible, and may produce death. It should be remembered that the carbonic oxide is without odor. Whole families have been fatally poisoned with it. Especial care must be taken with coal stoves which are used in bedrooms, or in rooms which communicate with bedrooms, as the carbonic oxide may prove fatal to persons while sleeping, without waking them; but there is no danger if the stove and flue be in proper condition. Makers of wrought-iron stoves and furnaces will insist that these gases pass readily through cast-iron, and for this reason their stoves are superior, and free from danger; but a properly constructed and properly managed cast-iron stove or furnace is free from danger, and in many respects is superior to those made of wrought-iron. Especial attention should be paid to the position of dampers in coal stoves at night.

One of the greatest objections to the use of stoves is, that in houses in which they are used, there is generally no attempt at ventilation. However, a house heated with stoves may be as well ventilated as any other. In houses as ordinarily built, much fresh air will come in through the crevices around the doors, windows, and baseboards. But if many occupy the room, the amount of fresh air which finds admittance through these channels may be insufficient. Especially is this likely to be the case if the room is partly surrounded by other parts of the building, and consequently has but a small surface directly exposed to the outdoor air. Besides, the direct draughts from doors and windows may be so great as seriously to affect the health of the inmates, giving them colds. When any of these troubles exist, one of several simple devices may be resorted to in order to secure the admission of plenty of fresh air without dangerous draughts. The most common of these devices consists in fitting a piece of board from four to eight inches wide in the window frame, under the

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lower sash. By this means, a space is left between the bottom of the upper and the top of the lower sash, through which the air enters, and the current is thrown upward, striking the ceiling, from which it is diffused all over the room. Dr. Keen recommends tacking a piece of cloth across the lower eight or ten inches of the window frame, then raising the lower sash to a greater or less extent, according to the weather. In this way two air-vents in the window are established, one under the lower sash, the current of which is turned upward by the cloth, and the other between the upper and lower sash, as when the board is used. Through the upper vent it is supposed that some of the foul air will escape, though the current through this opening is not invariably outward.

What is known as Maine's elbow-tube ventilator consists of a board placed under a raised sash, as already described. This board carries two tubes, about six inches in diameter, which turn upward, and the ends of which are supplied with valves, by which the amount of inflowing air can be regulated.

Another method provides for smaller tubes brought through the wall and turned upwards into the room. Some favor still another plan, which consists in bringing a tube about six inches in diameter through the wall, and, possibly, under the floor to the stove, where the tube terminates in a sheet-iron jacket placed around the stove, leaving a space of one or two inches, and having escapes only at the top of the jacket. The heat of the stove will produce a strong current through the pipe, and the incoming air will be warmed in passing through the jacket.

By any of the above-mentioned devices, abundant facility may be furnished for the admission of fresh air; but as two bodies cannot occupy the same space at the same time, there must be provided some escape for the foul air. This should always be attended to in the construction of the house. For every room which is to be heated by a stove, there should be two flues, one for the smoke and other gaseous productions of combustion, the other for the removal of foul air from the room. The ventilating flue must come to the floor, just above which should be a register. When there is a fire in the stove, the upper part of the ventilating flue will be warmed by the smoke flue, and consequently there

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will be an upward current in it. In this way the withdrawal of the foul air is rendered certain. It should also be seen, in the construction of the chimney, that the inside of this ventilating flue is not left so rough as to impede the flow of air through it, and that it is not clogged with mortar or pieces of brick. A good draught through the ventilating flue is almost of as much importance as the draught of the smoke flue.

The partition between the smoke and ventilating flues should be of brick placed on edge, thus making it as thin as possible, so that the upper part of the ventilating flue will be thoroughly heated from the smoke flue. By another method the smoke flue may be made of iron pipe placed in a large flue, and the space all around the pipe will serve as the ventilating flue. I have stated that the register in the ventilating flue should be near the floor. If near the ceiling, as some would have it, there would be too great a loss of heat, as the fresh air, as soon as heated, would find its exit. For summer ventilation, the foul air outlet may be at or near the ceiling, but such ventilation in winter costs too much, and, besides, when it is used, great difficulty will often be experienced in heating the room.

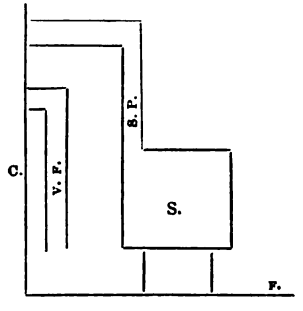

Fig. 1. — F., floor; S., stove; S. P., stove pipe; V. F., ventilating flue; C., chimney.

With the plan recommended above, there is no reason why any room heated with a stove may not be so well ventilated that no disagreeable odor will be perceptible to the most sensitive person upon coming in from the outdoor air; provided, always, that the room is clean. Unfortunately, however, the great majority of houses which are heated by stoves, are built without the slightest provision for ventilation. In such houses, fresh air may be introduced according to the methods already given; but the escape of the foul air is more difficult to be provided for. It may be done, however, as follows: Place a tin or sheet-iron pipe, of from six to ten inches in diameter, according to the size of the room, along the wall behind the stove. The lower end of

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this pipe extends to within a few inches of the floor and remains open, while the upper end passes, by means of an elbow, into the smoke flue below the point at which the stove pipe enters, as shown in the accompanying Fig. 1. The upper end of the ventilating flue may, when the chimney begins near the ceiling, terminate in a jacket around the stove pipe, the jacket passing into the chimney, as here shown in Fig. 2. In all cases, the ventilating flue is to have air-tight joints.

With the open fire or grate, the withdrawal of the foul air is all provided for, as it will escape up the chimney. The open fire is not so economical as the stove; but when sufficient to warm the room, the former is, at least, as both are ordinarily arranged, more healthful. With the open fire or grate, much of the heat escapes up the chimney; however, with the grate this loss of heat can be, to a considerable extent, lessened by setting the fire basket well forward.

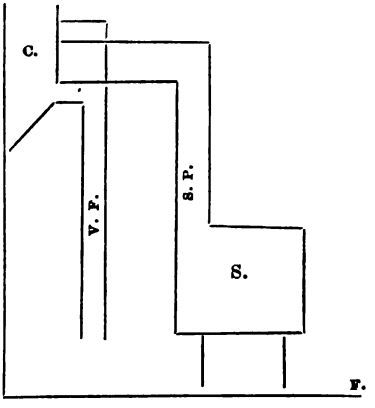

Fig. 2.

When the hot-air furnace is used, certain precautions are desirable, both for economy and health. In the first place, the furnace selected is nearly always too small for the extent of heating required of it. When this is the case, the fire must be pushed as much as possible in order to keep the rooms warm in winter; consequently, the air entering the room is overheated, and produces headache and dullness. At the same time the furnace is soon burnt out, and any money saved in the first place by purchasing the smaller size will have to be expended with an additional amount in securing a new furnace.

The furnace should be thoroughly incased with thick brick walls, to prevent great loss of heat by direct radiation in the cellar. The owner of the house will be rewarded for his time and trouble if he sees to it that this work is well done.

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The furnace must receive the air which is to be heated directly from the outdoor air, and not from the cellar. The cold-air duct should be perfectly air-tight, so as wholly to prevent the cellar air from entering the heating chamber. Wooden air-boxes are not to be recommended unless they be carefully lined with some metal. The external opening of the cold-air box should not be near any cesspool, drain, or other possible source of deleterious gases. It should also be protected by a piece of wire net. In the cold-air duct, preferably near its external opening, should be a sliding valve, by which the amount of air passing to the furnace can be regulated; but care must be taken that this valve is never entirely closed. Probably it would be better to have it made so that when pushed in as far as possible it will obstruct only half the area of the duct.

The air-chamber in the furnace should be kept supplied with water. The hot-air flue should be so arranged that the horizontal ones are not more than fourteen or sixteen feet in length, for if the horizontal flues be much longer than this, the draught through them will be so slight that the rooms will not be warmed, while the rooms supplied with vertical pipes will be overheated.

The warm-air register in the room should not be placed directly in the floor, but in the baseboard. If placed in the floor, it soon receives a large amount of dust and other refuse.

With a hot-air furnace properly selected and arranged, the amount of warm, fresh air entering the room is sufficient. But before the fresh, warm air can enter, the air already present must find an exit. The following principles may guide us in economically ventilating a room heated with a hot-air furnace: —

1. Bring the fresh air in near the floor.
2. Take the foul air out near the floor.
3. Create a draught in the foul-air shaft by means of heat.

Unless the air already in the room has some means of exit, it will be found utterly impossible to heat the room with the warm-air furnace. Then it will be seen that both the heating and ventilation depend largely upon the withdrawal of the foul air. If the foul-air register be near the ceiling, much of the warm air from the furnace will escape directly into the foul-air shaft. If there be an open fire in the room, the foul air will find a ready

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exit through the chimney. If there be only a ventilating flue, it should be in the same chimney with some other flue which is heated, at least in its upper half. Thus a number of ventilating flues from as many rooms may be placed in the same chimney with, and arranged about, the smoke flue of the furnace. Often we find that one ventilating flue is expected to do service for a room on the first floor, and also for another directly over it on the second. The result frequently is that the foul air of the lower room passes into the room above. There should be a separate ventilating flue for each room.

WATER-SUPPLY.

It is of the greatest importance to the family that its supply of drinking-water be of unquestionable purity. That such dreaded diseases as cholera, typhoid fever, scarlet fever, diphtheria, and dysentery may be spread by impure drinking-water, there can now be no question.

The sources of drinking-water may be divided into the following classes: —

1. Cistern water.
2. Surface water.
3. Subterranean water.

Cistern water is that which is collected upon the roof of a house, and stored in a reservoir known as a cistern, or in a tank, which is usually placed in the attic of the house. Cisterns, or underground reservoirs, are more generally used than tanks.

The condition of this kind of water will be influenced by the air through which it falls, by the nature of the roof, and by the kind of cistern, and the care exercised in keeping the roof and cistern clean.

In large cities, especially where there is much manufacturing done, there is always a considerable amount of dust and other impurities in the air, much of which is brought down with the rains. The conductors leading from the roof to the cistern should be supplied with means for turning off the first part of the rainfall. In this way the impurities taken from the air and those collected on the roof are disposed of. Especially is this desirable if the roof be of wood and old, if there be a collection of leaves

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and other *debris* from projecting branches of trees, and if there be any chance of birds depositing their excrement upon the roof. Probably the cleanest roofing material is slate; but its cost has prevented its general use in the construction of residences.

The cistern should be built of brick, and plastered water-tight upon the *outside* as well as upon the inside. Strict attention should be paid to this, and the walls should be so built as to prevent the possibility of water from the adjacent soil passing into the cistern.

The top of the cistern should be well covered, so as to prevent small animals as well as vegetable refuse from falling in. The best covering would be a box built up several feet above the ground, and covered with fine wire netting. In this way the fresh air will pass down, and the space above the surface of the water will be ventilated. When this cannot be used, a tight covering of stone, or of wood, if all boards are removed and replaced by new ones at the first sign of decay, may be used.

A wooden pump should not be placed in the cistern, as it soon decays, becomes covered with moss, and collects upon it much filth. An iron pipe with the pump in the kitchen is probably the best arrangement. However, the cistern should never be built under the house. When so built the air above the water is invariably bad, and the periodical cleaning out of the cistern, which should be done once a year at least, is not so likely to be attended to.

It is customary in some places to place near the top of the cistern an overflow pipe which leads into a cesspool or privy-vault. This practice has, without doubt, cost many lives. There should not under any circumstances be any connection between the cistern and any receptacle of filth. This overflow pipe is often untrapped, or the trap becomes defective, and the gases arising from the decomposing matter of the cesspool and privy-vault pass into the cistern. Indeed, cases are known where not only the gas, but fluid refuse, has thus been poured into the cistern.

However much care may be taken with the cistern, — and the above suggestions should be deemed of imperative importance, — the cistern water should be filtered before used. Many cheap and effective household filters are made, and it is not necessary

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to go into detail concerning their construction; but a few practical hints may be given as to their care. A filter which is kept constantly under water soon becomes utterly worthless. The charcoal box should be frequently exposed to air, and, if possible, to direct sunlight. A filter removes suspended matter, and, on account of the air condensed in the pores of the charcoal, destroys to a certain extent the organic matter held in solution in the water. If any epidemic disease prevails at the time, it is always safest to boil any and all water used for drinking purposes. Cistern water may be boiled and then filtered. If one has no regular filter, it will be better at all times to boil the water, after which it may be allowed to run through a piece of filter paper, which can be obtained for a trifle at any drug store, placed in a tin or glass funnel. When filter paper is used, a new piece should be placed in the funnel each day.

The purity of surface water will depend on the condition of the soil upon which it falls aud over which it flows, as well as upon the air through which it falls. Water which falls upon and flows over a filthy soil should not be used for drinking. Since the amount of refuse on the surface of the earth is usually greater in thickly settled countries, the water collected on such sheds is unfit for use. That there is a certain degree of purification in running streams there can be no doubt; but, notwithstanding this, specific poisons have been carried long distances in rivers, and have still manifested their poisonous effects.

When any serious epidemic prevails, and surface water constitutes the drinking supply, it should always be boiled. In India, the spread of cholera is often along the water-courses into which excrement from the sick and the bodies of the dead are often cast. Typhoid fever and dysentery are also often spread by the use of surface water.

The water collected in shallow wells is really surface water, and that often of the worst kind. The use of drinking-water from shallow wells is, as a rule, to be condemned. Many people think if water percolates through a few feet of soil, every harmful substance is removed. No greater mistake could possibly be made. Indeed, by percolation through the soil, the impurity of the water is often increased. Various kinds of filth which have accu-

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mulated upon and within the soil are dissolved in the water and carried into the well. Often we find in a small back yard a cesspool, privy-vault, and well, all in close proximity. If the well be a shallow one, such an arrangement is probably the worst, in a sanitary sense, that could possibly be devised.

Subterranean waters used for drinking purposes are those obtained from springs and deep wells. Whether such waters are pure or not depends largely upon the geological formations in which they exist. The source of the water must be below rock or thick clay beds in order for the water to escape surface contaminations. Springs from gravel hills may be as impure as shallow wells. A very small amount of iron in water does not render it unfit for drinking, but water which contains more than one tenth of one per cent of iron is unfit for constant use.

Deep wells should have their walls so protected as not to permit of surface water finding its way through them. If this is not the case, their waters may become quite as foul as those of shallow wells.

Subterranean waters are often hard. By this is meant that they fail to make a lather with soap, or a large amount of soap must be used with them in order to produce a lather. The hardness of water is due to the presence of certain inorganic salts, as those of lime and magnesia, which form insoluble compounds with soap. Hard waters are divided into two classes: —

1. Those whose hardness is removed by boiling. This is known as temporary hardness.

2. Those whose hardness is not removed by boiling. This is known as permanent hardness.

Many waters possess both a temporary and permanent hardness. Such waters are improved by boiling, but are not rendered wholly soft.

Hard waters are not suitable for laundry purposes, especially when the hardness is largely permanent. They also often form incrustations in boilers. But unless the hardness be very great, it does not unfit the water for drinking purposes. There has been much discussion as to the possibility of hard waters producing goiter. It is well known that this disease is very prevalent in certain limestone districts, but that the use of hard water for

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drinking is the cause of the disease has not been positively demonstrated. It would be best, however, for families in which a tendency to goiter prevails to use soft water.

Hard water has also been supposed to favor the formation of gravel. The writer has met with a few persons who are troubled with gravel only when using hard water.

Some hard waters have an irritating effect upon the bowels of those not accustomed to their use, producing in such persons diarrheas.

In case of the use of a public water-supply, it is the duty of the health authorities of the city to see that the water is wholesome, and it is the duty of the consumer to see that the water is not contaminated on his premises. Lead pipes and lead-lined storage tanks should not be used for conveying or storing cistern water. The pipes should be of iron, or better still, of block tin, or should be lined with tin.

THE DISPOSAL OF WASTE.

One of the most important questions connected with modern sanitation is as to the best methods of disposing of waste matter. When allowed to accumulate in the vicinity of homes, it may poison both the water and the air. Many of the older cities of southern Europe have become thoroughly saturated with filth, and for this reason cholera has found a fertile field for its growth in Spain, Italy, and southern France. Filth and disease always go hand in hand, the former leading the latter. Cleanliness invariably lessens the death-rate. Typhoid fever, cholera, and other diseases, whose growth and spread are plainly due to the accumulation and putrefaction of waste matter, should be stamped out of existence. With perfect cleanliness they would not be known.

It is the writer's object to give here some practical suggestions for the disposal of waste matter. Probably the disposal of human excrement deserves more care than any other waste. In cities where there is an abundant public supply of water, and where sewers are in use, the water-closet is the most convenient method, and it may be made perfectly safe. Where water-closets are used, the so-called "separate system" of sewerage is desirable. This system provides two sets of sewer conductors. One of these is

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the ordinary brick sewer, and this system is used only for carrying off the storm-water. The other is made of small sewer pipes which convey the sewage proper, and which are connected with flushing tanks, by means of which they are periodically flooded with water and washed clean. The advantage of this method is easily understood. When the single system is used, the sewers are necessarily large, in order to carry off the great amount of rain-water. The bottom and sides of these sewers must be more or less rough, and they are flushed only at the time of heavy rainfalls; consequently much of the time the flow of sewage through them is slow, and the solid matter is deposited on the rough surfaces, where it decomposes with the formation of noxious gases, which escape through ventilators into the street, or pass through defective traps into the houses.

With the separate system the small sewer pipes with smooth inner surfaces are flushed three or four times a day, and their contents are swept out. It requires twenty-four hours at least for human excreta to decompose to such an extent as to evolve poisonous gases; therefore, if the pipes be flushed clean one or more times during the day, there can be but little danger from "sewer-gas."

However, whichever system of sewerage is in use, the individual should take certain precautions in arranging his water-closets. In the first place, water-closets should not be placed in living-rooms or in bedrooms. They should be located, if possible, in some detached part of the house. The kind of closet selected should be determined upon by some competent person. Changes and improvements in the patterns are being constantly made, so that should any preference be given at this time it might not hold good three months hence. The flushing-tank for the water-closet should not in any way be connected with the drinking water supply. The closet should be well trapped, and the trap should be so placed that it can be examined at any time without tearing up the floor or breaking into the wall. The habit which plumbers have of hiding all their work should be condemned. The soil-pipe should not be connected at any point inside of the house, at least with the other waste pipes, such as those from the bath-tub and stationary wash-bowls. The soil-pipe

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should be ventilated by a pipe which should be as nearly perpendicular as possible, and which should extend above the roof of the house, and should not be placed near a window. This ventilation of the soil pipe is of the utmost importance, and should never be neglected.

When there is no system of sewerage, the dry-earth closet is the best method of disposing of human excrement. Indeed, upon sanitary grounds, the dry-earth system is in many respects more desirable than the use of water-closets; but the former requires possibly more care than the latter. Economically, also, the dry-earth system will prove the better when it comes into more general use, and the excrement is used as a fertilizer. A dry-earth closet properly kept is free from all noxious gases, and there is no possibility of the drinking water supply becoming contaminated from it.

There are many patterns of dry-earth closets in use, but the simplest may be made as efficient as the most complicated and costly. A cheap form is made by placing under the seat boxes or drawers lined with galvanized iron. There is placed conveniently a quantity of dry earth, and for each evacuation a small shovel of the earth, from one to two pounds, is thrown in. When the drawers are full they are removed, emptied, and replaced. The best earth to use is pulverized clay mixed with about one third its weight of loam. Ordinary garden soil may be used, if dried perfectly. Sifted coal ashes are almost or quite as good as any earth. Moreover, they are generally on hand, and to be disposed of in some way. The writer has used for his family a dry-earth closet for three years, and prefers the sifted coal ashes to any kind of earth. Gravel is not at all suitable.

With an ordinary family with not more than half a dozen members it is not necessary to empty the boxes more than once in three or four weeks. Their contents, which, if enough soil or ashes has been added, are wholly inodorous, may be emptied upon the garden. Here it is spaded in during the spring, and as a fertilizer amply repays for the time and trouble that has been taken with it. Several large cities in Europe have adopted the dry-earth system, and the waste is removed by those who desire to use it as a fertilizer.

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The patent earth-closets are so arranged that the requisite amount of earth falls into the box in a manner similar to that by which the water-closet is flushed with water.

In case epidemics of any kind are prevailing in the neighborhood, it would be well to throw a handful of chloride of lime into the closet each day. And even when no epidemic prevails, but the weather is very hot, the same quantity of sulphate of iron (copperas) may be used daily. The cost of this substance is so small that it may be used freely when needed. Where many are using the closet, a vault may be dug beneath the seat, and made water-tight with brick and cement. Into this should be thrown each day a sufficient quantity of dry earth, and the vault should be thoroughly cleaned at least once a month.

The ordinary privy-vault with porous walls is an abomination. It has caused more deaths in this country than war and famine have produced. The liquid poisons from it filter into wells, while its gaseous exhalations float through the air. People breathe and drink their own excretions, and typhoid fever and kindred diseases slay tens of thousands annually. It is safe to say that the privy-vault is the origin of the majority of the cases of typhoid fever. As the country becomes more thickly settled, the dangers from the privy-vault increase, and they should be wholly abandoned.

In many places it is the custom to move the privy, and cover the contents of the vault with a few shovels of dirt as soon as the vault is filled. In this way from one to half a dozen repositories of filth are formed in the average village back yard in a few years. Such a condition is certainly a highly unsanitary one.

The waste-pipes from the bath-tub and stationary wash-bowls should be well trapped, with the traps where they can be readily examined; and, as has been stated, these waste-pipes should have no connection, inside of the house at least, with the pipe from the water-closet. In the absence of sewage, the waste-pipes from the bath and bowls may be conducted into a cesspool. If the soil be gravelly, this cesspool should be lower than the bottom of the cistern, if the cistern be near. Its walls may be of stone or brick loosely laid, and a ventilating pipe should pass from the top of the cesspool and extend at least ten feet above the surface.

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No kitchen or laundry waste should be allowed to pass into this cesspool. Since the water passing into this cesspool comes only from the bath and wash-bowls, it does not contain a great deal of organic matter, and will pass into the soil. The cesspool for the kitchen slops should be walled up and made water-tight. This cesspool should also be ventilated by means of a large vertical pipe. The top of this cesspool should have a manhole in its center, covered with a stone or iron slab, which can be removed in order to clean out the cesspool.

It is better for all pipes leading to sewers and cesspools to be disconnected, or furnished with gully traps, or with an air pipe just outside of the house, in order to prevent the possibility of gas passing from the sewer or cesspool into the house. All cesspools should be as far from the house as possible, and they should be cleaned at regular intervals. The contents of the kitchen cesspool may be used for fertilizing.

All solid kitchen waste should be removed daily by a scavenger, who does this without expense to the householder, or it may be dried under the kitchen stove in shallow pans and then burned in the kitchen fire, or, if in the country, it may be fed to hogs or other animals.

The dust swept from the floor should be burned, not thrown out into the yard. Ashes should be kept in a dry place, and if so kept they may often be disposed of without cost. The soap-maker will pay for dry wood ashes, and coal ashes are often sought for and used for filling in low places. Each fireplace and grate should be furnished with an ash-pit in which the winter's product may fall, and by which accident from fire is greatly lessened.

When a house is built, a plan of all its drainage pipes should be made and preserved, as with it a faulty pipe or joint may often be found with ease, when without it much work may be necessary in order to find where the trouble is.

THE SURROUNDINGS.

It would be better if residences were not built up in solid blocks. Even narrow passage-ways between the houses, through which the air can move freely, are to be preferred to unbroken

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blocks. However, the price of land and of building material may compel some in the larger cities to deny themselves any further separation from their neighbor than that afforded by a single brick wall. But under no consideration should residences be built back to back, without any open space between the kitchens of the two houses. Even a few feet of open yard are of great benefit in affording ventilation, and in preventing excessive dampness. The yard should be kept scrupulously clean, and it should be rendered as beautiful as circumstances will permit. In summer there is no place for children in their play preferable to a nice spot out of doors.

The arrangement of cesspools, wells, cisterns, and outhouses has already been discussed. None of these should be allowed to contaminate the soil or air of the yard. Trees, not too dense or too near the house, are beneficial in shutting off dust and tempering the heat of the summer's sun. Besides, no other ornament about the premises can be more attractive than beautiful trees.

The location of all the outhouses of the immediate neighbors, as well as those directly on the premises, should be taken into consideration. The yard should be so graded that the surface water will not collect about the foundations of the house.

A little care and a trifling expense in the surroundings will amply repay any family, and will increase one's love for what should be the dearest spot on earth — home.

THE CARE OF THE HOME.

Suppose that a location has been selected, a house built, and the surroundings prepared according to the foregoing directions, the next thing is to see that all is kept in a sanitary condition. Some families would convert the most scientifically constructed house into a den of filth. Cleanliness should be the watchword of every family. So far as sanitary needs are concerned, all the directions under this head might be condensed into the few words, "Keep everything clean."

Decaying vegetables must not be left in the cellar. Fresh air is to be admitted daily into every part of the house, from cellar to garret. Bedrooms especially are to be thoroughly aired. Refuse bits of food are not to be left to mold on the pantry shelf,

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nor should they be thrown out into the back yard. Better burn them. Offal from the preparation of food is not to be allowed to remain in the house, nor is it to be thrown out. It must be placed in the swill barrel, or burned. Dirty dishes are not to go unwashed, nor filthy floors unscrubbed, nor soiled linen unlaundered.

Fresh meat, milk, and other foods are not to be allowed to remain uncovered in living-rooms or bedrooms. The flour-box is to be kept free, not only from the ravages of rats and mice, but from the dust of the room.

The drain from the ice-box should not be allowed to pass into a cesspool, sewer, or soil-pipe. Indeed, there should be no kind of connection between the ice-box, or other place in which food is kept, and any receptacle of waste matter.

The floors and seats of water-closets and earth-closets are to be kept clean. Drains and cesspools must be attended to. The supply of drinking-water must be kept free from every contamination.

Continued health is the reward for the care bestowed upon these details. The labor brings a rich return.

BUYING OR RENTING A HOUSE.

Great care should be exercised in renting or buying a house for family occupation. Many houses are now built purposely to rent or sell, and too many of these are constructed in a very flimsy manner. The object of the builder is to attract attention to his house, and money is spent in ornamentation, which should have been used in the more important parts of the structure. No one should place his family in a house until he has made a thorough investigation of its sanitary condition. The mere advertisement that "the house is furnished with the most approved sanitary appliances" should not be considered as a sufficient guaranty. Indeed, the statement of the owner or agent, that "everything is all right," is usually not to be relied on. The time will come when no one will be permitted to rent a death-trap in the shape of a house; but, unfortunately, at present the duty of seeing that everything is really all right devolves upon the person seeking a house. For this reason a few practical directions for house inspection may not be out of place here. The writer has known a

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man, even after having been warned by a former tenant, who placed his family in a house whose sole recommendation was its attractive appearance, and to regret his rashness a few weeks later when typhoid fever had stricken his family. The dangers to health and life are too great to allow any one to be careless or indifferent in this matter.

The house offered for rent or sale should be visited by the one seeking a home, and thoroughly inspected in regard to its sanitary condition, as well as to its general appearance. The surroundings should be studied. The condition of the back yard, — especially the location of outhouses on the premises and those of the neighbors, — the location and condition of cesspools, privy-vaults, cisterns, or wells, if such be present, should undergo careful inspection. What the sanitary arrangements should be has been already sufficiently indicated.

The cellar should be visited, and if its walls be cracked, damp, and covered with mold, if water stands upon its floor, and if light and ventilation are not provided for, seek some other habitation. It is better far to sleep in the open air, with no roof but the sky, and no bed but a few blankets placed on the dry earth, than to live in a house built over a reeking cesspool; and such a cellar is nothing more nor less than a cesspool.

The general construction of the house should be closely scrutinized. Observe the height of the first floor above the level of the street, the proportion of the lot covered by the house, the arrangement and size of the rooms, and the condition of the floors, ceilings, and walls. Of course, newly constructed walls are always damp. A great amount of water is used in the mortar and plastering, and much of this must evaporate before the building is fit for occupation. Neither should a house freshly painted with lead paints be occupied until the paint is well dried. The living-rooms should be placed upon the sunny, airy side of the house. The bedrooms especially should be examined with reference to their size and means of ventilation. The floors should be of seasoned wood, well jointed. This is very desirable, as it prevents the accumulation of dirt under the floors, and permits the free use of water in scrubbing the upper floors without danger of injury to the ceilings of the lower rooms.

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"Skin" houses, put up by "jerry" builders simply to rent or sell at the highest price, can usually be recognized by careful inspection. Extra ornamentation will generally be observed, but if a few months have elapsed since its construction, doors will be noticed not to close tightly, the woodwork is shrunken, the window-sashes do not move easily, and too frequently the foundations have settled and the walls cracked.

If the house be furnished with any plumbing, this should undergo thorough inspection. A map showing the distribution of the pipes, unless all are in plain view, should be furnished by the owner. In many old houses large brick drains are found in the cellar. These are always bad. In them a great quantity of filth accumulates. They are seldom sufficiently flushed. Such a condition should lead one to reject a house for residence. If the drain in the cellar be of earthen pipe, its joints should be examined, for they are often imperfect and allow of the escape of both gaseous and liquid contents. In this way the cellar floor becomes impregnated with filth and from it noxious exhalations rise into the rooms above. The writer has known of more than one instance in which one of these drains has been broken by settling, and the consequence was that a regular cesspool was formed instead of the drain. In one instance the break occurred near a cistern, and much of the chamber and kitchen slops soaked through the imperfect cistern, polluting the water; and this was the probable cause of the typhoid fever which attacked four of the inmates of the house. Still worse is the box drain made of plank. Often at the junction of the vertical pipe with such a drain, the wood decays, and a filthy cesspool is formed.

Unfortunately, in most cities, the sewers pass along the street in front of the house, and the sewage is collected in the back part of the cellar, and carried by a drain under the floor for the entire length of the cellar, passing out under the front wall on its way to the sewer. The best place for the sewer is in the rear of the house, but when in front, the drain should be carried around the house; or, if through the cellar, it should consist of an iron pipe freely exposed along its entire length, and with sufficient fall to give a rapid current. Its grade should be uniform, and free from depressions in which accumulations might occur.

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The proper arrangement of the soil-pipe has already been referred to. It should be of iron, not of lead. Leaden soil-pipes are often corroded and leaky. The ventilation of the soil-pipe should be by means of a pipe extending above the roof. The water conductor from the roof should not be made to do service as a ventilating pipe. Moreover, when the rain-water conductor empties into the soil-pipe, the force of the current through it will siphon the traps above unless they are all ventilated.

The location of all traps should be ascertained, and it should be seen that none of the pipes are either clogged or leaky. The desirability of the separation of the water-closet from the bath and wash-bowls has already been referred to. It is not desirable to have even stationary wash-bowls in bedrooms.

If there be a water-supply, it is well to see, before renting or buying the house, that all the pipes are in good order and so protected that they will not freeze. If the drinking-water be stored in a tank, see that the tank is not lined with lead. All water-pipes should be well supported, or they may sag and break.

The inspection of the method of heating and ventilating the building may be made from the rules in regard to these points already given. The same is true in regard to the disposal of garbage and the construction of earth-closets.

TENEMENT HOUSES.

Every workingman should strive to secure a home, and the tenement house can never be a home in any proper sense. The privacy and comfort of a home can never be secured in a tenement house. Here people of all kinds are congregated, and the noise of the boisterous will disturb the rest of the quiet; the filth of the slovenly is likely to injure the health of those who endeavor to keep everything about them clean; and the habits of the immoral are distasteful to the moral. However, on account of poverty, many good people are compelled, for a time at least, to occupy rooms in a tenement house. Unfortunately, the majority of such houses are built for the purpose of making as large pecuniary return to the owner as possible, and he cares but little about the character of his tenants, or the manner in which they live, so long as their rent is paid. In the large tenement houses of New

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York, all kinds of occupations are carried on, and many of them in the most slovenly manner.

The tenement should have a cellar under every part of it. The cellar should be divided into compartments by brick walls. No part of it should be used for sleeping-rooms, and it should be perfectly dry and well ventilated. The walls and floors throughout the building should be deadened. The halls should be lighted at both ends. They should be wide, and the space should not be encroached upon by using them as storage-rooms.

Each water-closet should be thoroughly trapped and ventilated by a pipe extending above the roof. The ends of these pipes should not have return bends, nor be furnished with caps which are likely to obstruct the upward current.

The water-pipes from baths, stationary wash-bowls, laundry tubs, and sinks should have no connection with the water-closets, and should discharge into the open air, outside the building over gullies, or should pass through air-traps outside of the house, the air-trap having a large ventilating pipe carried above the roof. In this way there will be no connection between the drain or sewer and the inside of the house, except through the ventilated soil-pipe of a trapped water-closet.

The floor and seat of every water-closet should be scalded with hot water and soap at least twice a week. There should be a separate closet for every fifteen persons.

The laundry work should be done in some special place, and not in the living or sleeping rooms. The water-supply should be abundant, and where the water-closets are used, not less than thirty gallons per day for each inmate of the house. Kitchens and bedrooms should be separate. The minimum amount of cubic space allowed should be five hundred cubic feet per head, and this amount will answer only when ample provision for ventilation exists.

Each room must be furnished with a separate flue for ventilation, or a foul-air shaft, which should be heated. These shafts may be heated by being placed in the same chimney with smoke flues, or in case the entire building is heated by steam, a number of foul-air shafts may be brought together in the attic and heated by a steam coil. If this is done, there should be no means of

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cutting off the steam from this coil. The method of removing foul air by means of a large central shaft may do when there are conductors leading from each room to such a shaft, but when it depends upon the foul air from distant rooms reaching the shaft by means of open doors or through transoms, it will often fail. Moreover, all attempts to ventilate a number of rooms on different floors through the same flue or shaft, it matters not how large it may be, will always prove more or less of a failure, because, on account of difference in temperature, the foul air from one room will often pass into another.

II.

HEALTHY FOODS.

FOODS AND FOOD-STUFFS.

Since particles of our bodies are constantly being worn away and cast out, new material must be introduced in order to make good the loss. Again, it is necessary that our bodies should be supplied with force or energy, that animal heat, muscular movement, and nervous activity may be maintained. For these reasons foods are taken.

Foods may be defined as substances which when taken into the body aid in building up or repairing tissue, or, by being oxidized or burned, generate force or energy.

Our ordinary foods consist of certain food-stuffs or elementary principles, together with a greater or less amount of wholly indigestible substances. Thus, oatmeal is a food containing the food-stuffs, gluten, starch, and fat, with a certain amount of cellulose (cell structure) which is of no service to the body. The nutritive value of a food depends upon the kind and amount of these food-stuffs that it contains. Since no satisfactory discussion of foods can be carried on until we become acquainted with those constituents upon which their values depend, we will briefly consider the food-stuffs. Fortunately they are not numerous, and may be divided into the following classes : —

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1. Albumens or proteids.
2. Fats or oils.
3. Starches or carbohydrates.
4. Inorganic salts.
5. Water.

Albumens or Proteids. To this group belong some of the most important food-stuffs. They all contain nitrogen, and for this reason the term "nitrogenous constituents" is used sometimes instead of proteids or albumens. The chief proteids are ordinary albumen, as the white of egg, casein of milk, fibrine of meat, gluten of grains and flour, and legumine of pease and beans. The amount of proteid in the different foods is variable, — thus, meat contains from 15 to 23 per cent; milk from 3 to 4; pease and beans from 23 to 27; grains and flours from 8 to 11; bread from 6 to 9; and potatoes and greens from 1 to 4.

When we remember that the blood, muscles, and all the vital organs contain proteids as their chief constituents, we can understand the importance of taking food rich in one or more members of this group. The average workingman requires in his daily food the equivalent of four or five ounces of pure proteid.

The digestive and assimilative organs have the power of converting one proteid into another, but they are not able to form a proteid out of a fat or a starch. For this reason no other food-stuffs can, without injury, be a substitute for the proteids in our food for any length of time.

Fats. Fats when oxidized or burned in the body produce more force than will arise from the combustion of an equal weight of any other food-stuff. In cold countries the inhabitants instinctively consume large amounts of fat on account of the heat which is generated from it. The workingman requires not less than two ounces of fat per day. Fats are best digested when taken in a finely divided state.

Starches or Carbohydrates. To this group belong a number of substances of similar chemical composition, and the majority belong to vegetable foods. The most important are starch, sugar, gum, and dextrine.

Like the fats, they are consumed in giving energy to the body, though a much larger amount of the carbohydrates is required to

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yield the same result to the body. The daily need of this food-stuff by the average workingman is between seventeen and eighteen ounces.

The cellulose or cell structure of plants is closely allied to the members of this group, and any cellulose that is absorbed must first be converted into sugar.

Mineral Salts. The bones of the adult man contain as much as 70 per cent of mineral matter, the greater part of which is the phosphate of lime. Smaller quantities of the phosphate of magnesium and the carbonate of lime also exist in bones. The muscles, blood, and tissues also contain salts of potash and soda, and some iron. One of the most important mineral foods is common salt or the chloride of sodium.

Water. About 70 per cent of the adult body is water. It forms the greater part of the vital fluid, in which it serves as the carrier of other substances, some in solution, others held in suspension. Besides the fluids, the solid tissues contain a greater or less proportion of water; the muscles contain as much as 75 per cent. There is also great loss of water by evaporation from the skin, by exhalation from the lungs, and by excretion from the kidneys and bowels. This loss must be made good by the drinking of water, and by taking foods more or less rich in this constituent. Meat contains about 75 per cent; milk, on an average, 87; bread, 35; and vegetables and fruits, from 70 to 90.

THE NUTRITIVE VALUE OF FOODS.

The nutritive value of a food will depend upon the proportion and kind of food-stuffs which it contains. However, there are many conditions which influence the nutritive value of a food.

In order for this to be high, its constituents must not only be rich in food-stuffs, but they must be digestible. By improving the digestion, the appearance, odor, and taste of a food increase its nutritive value. A certain method of cooking makes a food more acceptable to one, while another is pleased with a wholly different manner of preparation. The taste and odor, when pleasing, stimulate the flow of the digestive juices; and not only will more of the food be taken as a result, but a greater proportion of that which is taken will be digested and assimilated.

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It is also quite essential that the volume of food taken should be large enough to satisfy the appetite, and still not so great as to prove burdensome. For this reason foods poor in certain food-stuffs are usually taken with some other food rich in these constituents. Thus the potato, which contains not more than 2 per cent of proteids, is usually eaten with meat, which contains from 14 to 21 per cent of proteids; or we may say with equal propriety, that because meat contains no starch, man has learned to take with it the potato, whose chief constituent is starch. If one should attempt to live upon potatoes only, the weight of the food that he would have to take each day in order to get the minimum quantity of proteids upon which life could be sustained would not be less than ten pounds. Dr. Edward Smith actually found some of the poorest Irish laborers confined almost exclusively to potatoes, and consuming the amount given above. This would lead to distension of the digestive organs, and render one dull and stupid. The digestive organs of plant-eating animals form from 15 to 20 per cent of the entire body weight. In flesh-eating animals the digestive organs form only from 5 to 6 per cent of the body weight; in man the proportion is from 7 to 8 per cent. Thus man, upon this point at least, holds an intermediate position between flesh-eating and plant-eating animals, being more closely allied to the former than to the latter. However, as the proper cooking of the food aids digestion, man may digest some of the vegetable food even more quickly and completely than the ox can; but his food should not consist wholly of vegetable products. A certain amount of animal food, while not absolutely necessary to the maintenance of life, is essential to man's highest development.

The nutritive values of the different foods, as shown by the per cent of the various food-stuffs which they contain, will be given under the special description of each food.

THE ECONOMIC VALUE OF FOODS.

That food is most economical which contains the greatest amount of the most valuable food-stuffs for the least money.

The average workingman requires daily in his food, in round numbers, not less than four ounces of proteids, two ounces of fat,

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and eighteen ounces of carbohydrates. What combination of foods will furnish these for the least money? This is an important question; but in answering it, it should always be borne in mind that the foods suggested are to be healthy ones. A combination which would cost but little, but which would lead to dyspepsia or other ills, might in the end be quite costly.

The following formulas show some combinations, and give the approximate cost. It will be seen that the required amount, or more, of each food-stuff is present: —

CLASS I. — *Very cheap daily rations without meat.*

No. 1.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
26 oz. bread	1.82	0.13	14.35	5
2 oz. oatmeal	0.29	0.12	1.30	½
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
24 oz. potatoes	0.48		4.96	1½
4 oz. beans	0.92	0.08	2.14	1
2 oz. lard		1.98		1¼
	4.05	2.88	24.45	12¾

No. 2.

26 oz. bread	1.82	0.13	14.35	5
2 oz. fat cheese	0.50	0.58	0.04	1½
1 pt. milk	0.54	0.57	0.76	3
16 oz. potatoes	0.32		3.31	1
4 oz. beans	0.92	0.08	2.14	1
1 oz. lard		0.99		⅝
1 oz. sugar			0.94	½
3 5-oz. cups tea				1
	4.10	2.35	21.54	13⅝

No. 3.

16 oz. bread	1.12	0.08	8.83	3
4 oz. oatmeal	0.58	0.24	2.60	1
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½

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	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
32 oz. potatoes	0.64		6.62	2
1 oz. lard		0.99		5/8
5 oz. fat cheese	1.25	1.45	0.11	3¾
	4.13	3.33	19.86	13⅞

No. 4.

16 oz. bread	1.12	0.08	8.83	3
6 oz. oatmeal	0.87	0.36	3.90	1½
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
4 oz. beans	0.92	0.08	2.14	1
32 oz. potatoes	0.64		6.62	2
1 oz. lard		0.99		5/8
3 5-oz. cups tea				1
	4.09	2.08	23.19	12⅝

No. 5.

26 oz. bread	1.82	0.13	14.35	5
1 oz. rice	0.16	0.02	1.53	1
1 egg	0.12	0.12		1¼
1 oz. lard		0.99		5/8
4 oz. beans	0.92	0.08	2.14	1
4 oz. fat cheese	1.00	1.16	0.08	3
	4.02	2.50	18.10	11⅞

No. 6.

26 oz. bread	1.82	0.13	14.35	5
1 oz. macaroni	0.09		0.76	1¼
4 oz. beans	0.92	0.08	2.14	1
32 oz. potatoes	0.64		6.62	2
1 oz. lard		0.99		5/8
4 oz. fat cheese	1.00	1.16	0.08	3
1 oz. sugar			0.94	½
3 5-oz. cups of tea				1
	4.47	2.36	24.89	14⅜

Although the rations suggested in the preceding tables do not contain meat, they do contain more or less animal food, and are

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healthy. However, the writer would not recommend one to adhere constantly to them, as some meat, while not necessary to health, does undoubtedly increase bodily vigor.

The small amount of really nutritive matter in tea is not considered, and the reader is referred to the articles "Tea" and "Coffee" for a true explanation of the food values of these drinks.

It will be seen that among vegetable foods in common use, oatmeal, beans, and potatoes are the cheapest. Since the prices vary so greatly, not only at different times, but in different parts of the country at the same time, the price at which the computation is made is given in each instance; and if the prevailing price differs from that given, any one can ascertain the change that would be produced in the total cost of the daily rations.

CLASS II. — *Very cheap daily rations with meat.*

No. 1.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
26 oz. bread	1.82	0.13	14.35	5
2 oz. codfish	1.60	0.02		1¼
2 oz. lard		1.98		1¼
16 oz. potatoes	0.32		3.31	1
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
3 5-oz. cups tea				1
	4.28	2.70	19.36	13

No. 2.

16 oz. bread	1.12	0.08	8.83	3
1 oz. codfish	0.80	0.01		⅝
1 oz. lard		0.99		⅝
32 oz. potatoes	0.64		6.62	2
2 oz. bacon	0.29	0.75		1½
4 oz. beans	0.92	0.08	2.14	1
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
3 5-oz. cups tea				1
	4.31	2.48	19.29	13¼

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No. 3.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
26 oz. bread	1.82	0.13	14.35	5
2 oz. oatmeal	0.29	0.12	1.30	½
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
2 oz. codfish	1.60	0.02		1¼
8 oz. potatoes	0.16		1.65	½
2 oz. lard		1.98		1¼
3 5-oz. cups tea				1
	4.41	2.82	19.00	13

No. 4.

26 oz. bread	1.82	0.13	14.35	5
1 oz. codfish	0.80	0.01		⅝
2 oz. lard		1.98		1¼
6 oz. beans	1.38	0.12	3.21	1½
2 oz. fat cheese	0.50	0.58	0.04	½
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
3 5-oz. cups tea				1
	5.04	3.39	19.30	13⅜

No. 5.

26 oz. bread	1.82	0.13	14.35	5
2 oz. fat cheese	0.50	0.58	0.04	1½
2 oz. bacon	0.29	0.75		1½
4 oz. beans	0.92	0.08	2.14	1
1 pt. milk	0.54	0.57	0.76	3
1 oz. sugar			0.94	½
3 8-oz. cups coffee				2
	4.07	2.11	18.23	14½

No. 6.

26 oz. bread	1.82	0.13	14.35	5
2 oz. codfish	1.60	0.02		1¼
1 oz. bacon	0.14	0.37		¾
2 oz. lard		1.98		1¼
16 oz. potatoes	0.32		3.31	1

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	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
½ pt milk	0.27	0.28	0.38	1½
1 oz. sugar			0.94	½
3 8-oz cups coffee				2
	4.15	2.78	18.98	13¼

CLASS III. — *Moderately cheap daily rations.*

No. 1.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
16 oz. bread	1.12	0.08	8.83	3
8 oz. beef (very fat)	1.36	2.12		8
32 oz. potatoes	0.64		6.62	2
2 oz. oatmeal	0.29	0.12	1.01	½
1½ pt. milk	0.81	0.85	1.14	4½
1 oz. sugar			0.94	½
	4.22	3.17	18.54	18½

No. 2.

26 oz. bread	1.82	0.13	14.35	5
8 oz. beef (moderately fat)	1.68	0.45		9
16 oz. potatoes	0.32		3.31	1
1½ pt. milk	0.81	0.85	1.14	4½
1 oz. butter		0.83		1½
	4.63	2.26	18.80	21

No. 3.

26 oz. bread	1.82	0.13	14.35	5
4 oz. mutton (very fat)	0.60	1.44		4
4 oz. beans	0.92	0.08	2.14	1
1 qt. milk	1.08	1.14	1.52	6
	4.42	2.79	18.01	16

No. 4.

26 oz. bread	1.82	0.13	14.35	5
8 oz. mutton (moderately fat)	1.36	0.48		9
32 oz. potatoes	0.64		6.62	2
½ pt. milk	0.27	0.28	0.38	1½
1 oz. sugar			0.94	½

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	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
2 oz. butter		1.66		3
3 8-oz. cups coffee				2
	4.09	2.55	22.29	23

No. 5.

26 oz. bread	1.82	0.13	14.35	5
4 oz. pork (lean)	0.80	0.28		3
2 oz. fat cheese	0.50	0.58		1½
32 oz. potatoes	0.64		6.62	2
½ pt. milk	0.27	0.28	0.38	1½
1 oz. butter		0.83		1½
3 8-oz. cups coffee				2
	4.03	2.10	21.35	16½

No. 6.

26 oz. bread	1.82	0.13	14.35	5
2 oz. sausage (best quality)	0.57	0.80		1¼
2 oz. oatmeal	0.29	0.12	1.30	½
4 oz. beans	0.92	0.08	2.14	1
1 oz. bacon	0.14	0.37		¾
1 pt. milk	0.54	0.57	0.76	3
1 oz. butter		0.83		1½
1 oz. sugar			0.94	½
3 5-oz. cups tea				1
	4.28	2.90	19.49	14½

CLASS IV. — *More expensive daily rations.*

No. 1.

	Proteids. oz.	Fats. oz.	Corbohydrates. oz.	Cost. cts.
16 oz. bread	1.12	0.08	8.83	3
2 eggs	0.24	0.24		4
2 oz. butter		1.66		4
1 qt. milk	1.08	1.14	1.52	8
1 oz. bacon	0.14	0.37		¾
1 oz. string beans	0.03		0.06	2
8 oz. mutton	1.36	0.48		9
32 oz. potatoes	0.64		6.62	2
1 oz. sugar			0.94	½
1 oz. dried fruit	0.02		0.55	1¼
	4.63	3.97	18.52	34½

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No. 2.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
16 oz. bread	1.12	0.08	8.83	3
2 oz. oatmeal	0.29	0.12	1.30	½
2 oz. sugar			1.88	1
1 pt. milk	0.54	0.57	0.76	3
1 oz. macaroni	0.09		0.76	1¼
8 oz. beef	1.68	0.44		9
32 oz. potatoes	0.64		6.62	2
2 oz. salmon	0.32	0.11		1½
2 oz. butter		1.66		4
3 8-oz. cups coffee				2
	4.68	2.98	20.15	27¼

No. 3.

20 oz. bread	1.40	0.10	11.04	4
4 oz. beef	0.84	0.22		4½
2 oz. butter		1.66		4
2 oz. fat pork	0.29	0.75		1½
2 oz. beans	0.46	0.04	1.07	½
2 oz. starch			1.67	2
2 oz. sugar			1.88	1
2 oz. dried fruit	0.05		1.11	2½
8 oz. potatoes	0.16		1.65	½
8 oz. lean mutton	1.36	0.48		8
3 8-oz. cups coffee				2
½ pt. milk	0.27	0.28	0.38	1½
	4.83	3.53	18.80	32

No. 4.

20 oz. bread	1.40	0.10	11.04	4
2 oz. oatmeal	0.29	0.12	1.30	½
1 qt. milk	1.08	1.14	1.52	6
2 oz. sugar			1.88	1
2 oz. butter		1.66		4
2 oz. mackerel	0.46	0.13		1½
8 oz. chicken	1.86	0.19		12½
16 oz. potatoes	0.32		3.30	1
8 oz. fruit (as apple sauce)			0.80	1
	5.41	3.34	19.84	31½

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No. 5.

	Proteids. oz.	Fats. oz.	Carbohydrates. oz.	Cost. cts.
26 oz. bread	1.82	0.13	14.35	5
2 oz. sausage	0.57	0.80		2
2 oz. butter		1.66		4
8 oz. lean beef	1.68	0.08		9
16 oz. potatoes	0.32		3.30	1
2 oz. macaroni	0.18		1.53	2½
1 qt. milk	1.08	1.14	1.52	6
2 oz. sugar			1.88	1
3 8-oz. cups coffee				2
	5.65	3.81	22.58	32½

No. 6.

26 oz. bread	1.82	0.13	14.35	5
2 eggs	0.24	0.24		4
2 oz. butter		1.66		4
8 oz. lean beef	1.68	0.08		9
2 oz. beans	0.46	0.04	1.07	½
1 oz. bacon	0.14	0.37		¾
16 oz. potatoes	0.32		3.30	1
1 oz. sugar			0.94	½
1 pt. milk	0.54	0.57	0.76	3
3 8-oz. cups coffee				2
	5.20	3.09	20.42	29¾

To the cost of the raw food, as given in the preceding tables, is to be added the cost of cooking, fuel, keeping the table, and of furnishing seasoning, such as salt, pepper, and mustard. Where six or more persons eat together, the cost of the above items, including enough to pay the wages of the cook and waiters, is from 35 to 50 cents per week for each boarder. This increases the daily cost of board by from 5 to 7 cents above the figures given in the tables.

Animal Foods.

MEATS — GENERAL PROPERTIES.

A large proportion of our daily food consists of material derived from the animal world. Other animals take vegetable food

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and build it up, so that it approximates in physical and chemical properties the flesh of man. Of the foods thus derived from the animal kingdom, meat is one of the most important. Meat consists of different food-stuffs, as water, mineral salts, albumen, and fat. On an average, 100 parts of beef consist of 72 parts of muscle, 8 parts of fat, and 20 parts of bone (including cartilage and tendon). The age of the animal and the manner in which it has been fitted for market have a marked effect upon the composition of the flesh. Veal contains 3 per cent more of water, and a corresponding amount of solid substance, than lean beef. Fat beef may contain as much as 10 per cent less of water than lean beef. The same is true of the difference between mutton and lamb. Of all the kinds of flesh eaten, fat bacon contains the least amount of water. The average per cent of water in bacon is 60, while that in lean beef is 75. The flesh of wild fowl, chickens, and pigeons furnishes on an average 77 per cent of water. Fish is especially rich in water, the carp yielding 80 per cent. The fat in lean beef, veal, and mutton may be as low as from 1 to 1½ per cent, while that of fat beef is 14, of fat mutton 9, veal 6, and bacon 24. Along with these variations in the amounts of water and fat, there are corresponding changes in the quantity of nitrogenous material. As a rule, fish is poorest in nitrogenous substance, the per cent in carp and salmon being 13, in pickerel 15; fat veal, mutton, and bacon, 15; fat beef, 16; lean beef, 22.

The following rules may govern us in the selection of meats: —

Good beef has a reddish brown color, and contains no clots of blood. Well-nourished beeves furnish a flesh which while raw is marbled with spots of white fat; it is firm and compact. Old, lean animals furnish a flesh which is tough, dry, and dark; the fat is yellow. Veal is slightly reddish, and has tender, white fibers. The fat is not distributed through the lean, as in beef. The same is true of mutton. In well-nourished animals white fat accumulates along the borders of the muscles.

Pork is rose-red, and has fat distributed through the muscle. The lard is white, and lies in heavy deposit under the skin. The flesh of an old boar is dark, and often has an unpleasant odor and taste.

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Good beef is not of a pale pink color, and such a color indicates that the animal was diseased. Good beef does not have a dark purple hue, for this color is evidence that the animal has not been slaughtered, but has died with the blood in its body, or has suffered from some acute febrile affection.

Good beef has but little or no odor, or if any odor is perceptible it is not disagreeable. In judging as to the odor of meat, pass a clean knife, which has been dipped in hot water, through it, and examine subsequently as to the odor of the knife. Tainted meat often gives off a plainly perceptible and disagreeable odor while being cooked.

Good meat is elastic to the touch. Meat that is wet and flabby should be discarded. It should not become gelatinous after being kept in a cool place for two days, but should remain dry on the surface and firm to the touch.

The flesh of young animals is more tender than that of the adult, but experiment, as well as experience, has shown that the former is less easily digested. For instance, veal and lamb are less easily digested, and tax the stomach of the dyspeptic more than beef and mutton. Dr. Smith has shown that this is largely due to the fact that the flesh of young animals cannot be perfectly masticated. The tissues of the young animal are less stimulating, less nutritious, and more gelatinous than the tissues of the adult animal. On the other hand, it is well known that an animal may be so old and poorly nourished that its flesh well-nigh defies both mastication and digestion. The common breeds of cattle are best fitted for the market at the age of 7 years; the better breeds earlier.

It makes a difference whether the special meat be served in or out of season. Beef is in highest season in the early months of winter, after the animal has been furnished abundant pasturage, though not absolutely out of season at any time of the year. Fresh pork is wholly out of season during the hot months of summer. Christison found in salmon, before the spawning season, 18.5 per cent of fat and 39 per cent of solids; after the spawning season, 1 per cent of fat and 20 per cent of solids.

In most cases, animals are fattened for the table. Some fat is desirable, as it renders the meat more juicy, and develops an

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agreeable flavor. But the process of fattening is often carried too far. Fat should be taken in a finely divided state, for when swallowed in lumps it is well-nigh indigestible. Many a child which has been reproved for refusing to eat fat meat will readily take the same amount of fat, as butter, spread upon bread. The manner in which the animal has been killed affects the meat. Slaughtering is usually so conducted as to remove as much as possible of the blood. Either death is produced by the withdrawal of blood, or the blood is withdrawn as soon as possible after death. The removal of the blood enables the meat to be kept with more ease; it also improves the flavor.

In warm countries meat is often cut from the animal and cooked as soon as death is produced, and before *rigor mortis* (the stiffness of death) sets in. While the rigor is on, the meat is more difficult of mastication and digestion. In temperate latitudes the flesh is usually kept until this rigidity naturally passes off. This may be aided by pounding the meat after it has been cut into thin pieces. With us, the only animals which are cooked before rigor sets in are fish, frogs, some mollusks, frequently domestic fowls, and sometimes wild game.

The flesh of wild animals is richer in nitrogen and flavor, and contains less fat, than that of the same species kept in domestication.

Meat which has been frozen decomposes easily after being thawed out, and when cooked it is dry and insipid.

The ancient Egyptians and Chaldeans were acquainted with the fact that the flesh of diseased animals might harmfully affect those eating of it, and among them the use of such flesh as food was prohibited. The strictest measures were taken to see that the meat furnished their kings and priests was obtained from healthy animals. Even during the dark ages this prohibition of the use of flesh from diseased animals continued. During the eighteenth century, however, it was found that the inhabitants of besieged towns ate of such food when starvation threatened them, and without any marked detriment to health. The flesh of a diseased animal does not necessarily convey the malady to the consumer; but in order to prevent such transmission the cooking must be thorough. That phthisis (consumption) may be imparted to dogs

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by feeding them upon tubercular flesh has been proven experimentally. Dr. Livingston states that the use of flesh of animals afflicted with pleuro-pneumonia produces carbuncle. In Germany and France many cases of anthrax or malignant pustule in man have arisen from partaking of the flesh of animals with this disease. The flesh of sheep with the small-pox, and of oxen with the cattle plague, has affected those partaking of it. Then there are the parasites, trichinæ, cysticerci (in "measly" meat), and echino-cocci (flukes), which may be transmitted to man. If every part of the meat be raised to a temperature of 160° Fahr. during cooking, these parasites are destroyed; but if the blood-red juices exude from the interior of the piece of meat on being cut, the parasites, if present, may still retain their vitality.

The eating of the flesh of diseased animals is admissible only when no better food can be secured, and when starvation threatens. The sale of such meat is prohibited by law, and any one guilty of such an outrage should be punished to the fullest extent.

The flesh of a healthy animal may become poisonous from partial decomposition. By the putrefaction of albuminous substances, certain organic poisons are generated. The symptoms produced resemble those of severe cholera morbus, and a fatal termination is not infrequent. These cases most frequently arise from eating sausage and canned meats, though they may be due to any meat which is partly putrid.

Gerlach, director of the Royal Veterinary School at Berlin, gives the following list of meats which should not be eaten: —

1. The flesh of all animals which have died of internal diseases, or which have been killed while suffering from such diseases, and of healthy animals which have been killed by overdriving.

2. The flesh of animals with contagious diseases which may be transmitted to man.

3. The flesh of animals which have been poisoned.

4. The flesh of animals with severe infectious diseases, such as blood poisoning.

5. Flesh which contains parasites that may be transmitted to man.

6. All putrid flesh.

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METHODS OF COOKING MEAT.

In boiling meat, if it is desired to retain the juices, the piece should be large, and should be placed at once in boiling water, and the boiling continued for five minutes. Then the temperature of the water should be allowed to fall to 160° Fahr., at which point it should be maintained until the meat is done. The boiling water coagulates the outside of the meat, and thus prevents the escape of the juices. If the temperature be kept at or near the boiling point throughout the process, the flesh shrinks, becomes tough, loses in flavor, and is finally digested with much difficulty.

On the other hand, if the object of the boiling is to make a good soup, the meat should be cut into small pieces, placed in cold water, and the temperature gradually raised to from 150° to 160° Fahr. Chicken broth is the most nutritious, mutton next, while beef makes a very weak broth. By boiling, meat loses, as a rule, from 25 to 30 per cent of its weight.

In roasting, the oven should at first be very hot; then it should be cooled down, and the process continued at a low temperature. Since the heat applied to every portion of the outside of the meat cannot be so uniform in roasting as in boiling, the loss is usually greater in the former than in the latter.

Stewed meat is that roasted in its own juices. The meat is cut into small pieces, and the cooking should be carried on at as low a temperature as possible. The extracted matter should be served with the meat. Often vegetables are stewed with the meat, thus improving the flavor of the former.

Proper cooking renders the meat more agreeable to the senses of sight, smell, and taste, and thus through the nervous system it stimulates the flow of the digestive fluids. One of the most fruitful sources of error in the cooking lies in using too high a temperature.

BRIEF CONSIDERATION OF THE MEATS IN COMMON USE.

Beef. Among all civilized people beef is regarded as the principal animal food. By common consent, we admit that beef is more nutritious than any other kind of flesh. This universal

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opinion is supported by the investigations of science. There is a larger proportion of nutritious material in beef than in the flesh of the sheep or hog. Beef is of closer texture, and is fuller of red-blood juices. It is richer in flavor than the flesh of any other domestic animal, and a smaller amount of it will satisfy hunger. Siegert gives the following figures, showing the average per cent composition of the flesh taken from different parts of a lean and a fat ox: —

	Lean Ox.			Fat Ox.		
	Neck.	Sirloin.	Shoulder.	Neck.	Sirloin.	Shoulder.
Water,	77.5	77.4	76.5	73.5	63.4	50.5
Fat,	0.9	1.1	1.3	5.8	16.7	34.0
Muscle,	20.4	20.3	21.0	19.5	18.8	14.5

On an average, 65 per cent of the live weight of an ox may be converted into salable meat, the exact proportion varying with the degree to which the animal has been fattened. The greater the amount of fat, the less the proportion of bone and other waste.

Not only does beef from different animals differ in composition, flavor, and digestibility, but that from various parts of the same animal varies. The flesh from the different parts of the carcass is divided into the following four classes, according to quality: —

Class I. Porterhouse, sirloin, and best cuts from the rump; price per pound, 15 cents.

Class II. Round, shoulder, ribs, top ribs, flank steak, plate, and skirt, 12½ cents.

Class III. Best parts of neck, brisket, and flank, 8 cents.

Class IV. Poorer parts of neck, flank, and brisket, 7 cents.

Pieces of shank and bone are usually sold by the piece and not by the pound. The prices vary in different sections of the country and at different times, but the writer gives the above figures for the purpose of showing the difference in value of different parts from the same animal.

Veal. In many sections of the country, calves of all ages are slaughtered. In some cities, as in Boston,* the killing of a calf

* It is also forbidden in this state. — Sec.

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under one month of age for food is prohibited. It would be well if this law, or a more extensive one, should be enforced all over the country. Veal is too often used simply as a dish to please the taste. As has been remarked, it is not nearly so nutritious as beef, and is much more difficult of digestion. Some persons are wholly unable to digest veal, and when they eat of it, it acts as a foreign body in the intestines and causes griping and diarrhea. Dr. Smith states that it is more easy of digestion when well roasted or broiled than when boiled. The time required for the digestion of veal is five hours or more, while beef is digested in from two and a half to three hours.

The mode of killing often practiced in this case has a special influence on the nutritive value of the food. Veal is bleached by repeatedly bleeding the animal for some days, and at last allowing it to bleed to death. The bones of calves contain much animal matter, and for this reason they are used for the production of gelatine; and calves' feet are selected for the preparation of jellies, which are often very acceptable to the sick.

Mutton. This is more easily digested than beef, though in a healthy man no marked difference would be observed, since in the stomach of such a man there arises no inconvenience from the digestion of beef. However, mutton will be found to tax the stomach of the dyspeptic less than beef does, and mutton broth is both acceptable and valuable to a person suffering from dysentery or kindred affections of the bowels. But mutton is not so nutritious as beef.

In dressing a mutton the woolly coat should not be allowed to touch the flesh. There is quite a perceptible difference in the flavor of mutton taken from a fattened wether, which has been for some time deprived of all excess in his woolly coat, and of that taken from a sheep which has a heavy fleece. The smallest proportion of both fat and bone to muscle is found in the leg; consequently this is the most valuable part of the animal.

Lamb. This is not nearly so nutritious as mutton. The tissue is soft, gelatinous, and rich in water. It is used principally on account of its delicacy of flavor, which, however, is very variable, depending upon the breed and nourishment. Lamb should not be selected for those whose digestive organs are weak.

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Pork, Bacon, and Ham. As a rule, dried meats are more difficult of digestion than the same meats in the fresh state. Bacon and ham are, however, exceptions to this rule, for when well cured they are digested with more ease than fresh pork. In cold weather, nice bacon is especially suited for furnishing a large amount of heat by its oxidation in the body. The inhabitants of cold countries find fatty food necessary to their existence.

For several reasons, the flesh of the hog must continue to form one of the most important sources of our food. This animal can be fattened more readily and at less cost than either the ox or sheep. The best breeds of pigs store up in their bodies three times as much of the food which they eat as the ox does. Then the flesh can be cured easily and preserved indefinitely. Again, the animal multiplies rapidly and reaches maturity speedily.

On the other hand, of all the meats ordinarily eaten, this is most likely to be diseased. "Measly" pork can, as a rule, be recognized by the unaided eye on close inspection. The meat is dotted with grayish-white specks about the size of a pea; but "measly" pork is often cut up into sausage, in which the diseased condition escapes recognition. The "measles" (cysticerci), taken into the stomach of man, develop into tape worms. Then there are the trichinæ, which can be recognized only by the aid of the microscope. These little parasites penetrate the muscles of man, causing great suffering, which often terminates in death. These parasites occur so frequently in pork and its cured products, that every one should always remember that the flesh of the hog should not be eaten unless it has been thoroughly cooked. As we have stated, these parasites are destroyed if the temperature of every part of the meat be raised to 160° Fahr. during cooking.

Fowl. There is no bird that may not be eaten in case of necessity. In other words, the flesh of no bird is in itself poisonous. The same is true of the eggs of all birds. It is true that cases of poisoning from eating quails during spring have occurred; but the poisoning was due to the buds of the mountain laurel upon which the birds fed. The flesh of carnivorous birds is strong in odor and in taste, and would not form a tempting dish, save to one threatened with starvation. The light meats of birds are more easily digested, less rich in nitrogen and in flavor, than the

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dark meats. Chicken broth is more nutritious than that made from either mutton or beef, and is often of great value to the sick.

Fish. Undoubtedly the flesh of some fish is poisonous. A fish is said to justify suspicion when it has attained a size unusual for one of its species. This popular idea may have a grain of truth in it. Fish should be discarded if the water in which it is being boiled blackens silver. The coloration is due to hydrogen sulphide (the gas of bad eggs), and indicates putrefactive changes. Decomposing fish has a pale look, and its belly is bluish. It is withered, sticky to the touch, and foul in odor. The seller sometimes tries to hide the evidence of decomposition by taking the eyeballs out and coloring the gills with blood. Fish caught from putrid water should not be eaten. Sometimes, near large manufacturing establishments where a great deal of refuse is thrown into the water, the fish are killed, and may be brought to market. The flesh of such fish is yellowish, soft, spongy, and of foul odor. Fish may be divided into those furnishing white and those furnishing red meats. Those of the former class, as the whitefish, are delicate and easy of digestion, while those of the second class are richer in nitrogen, and more stimulating. Fish should not be left in the water after they are dead, but should be packed in ice.

Fish should not be the chief flesh diet of a people, because it is not sufficiently stimulating. Indeed, it is doubtful if any class of people would voluntarily confine themselves to such food; but the occasional use of fish forms a change which is both agreeable and beneficial. There is no truth in the popular idea that a fish diet is especially suited to the development of the brain and nervous system.

Along with fish are often classed certain crustaceans, as the crab and lobster, and certain mollusks, as the oyster and mussel. The oyster and mussel are gelatinous, but are easily masticated and digested. The lobster, crayfish, and crab are more muscular, and are somewhat more difficult of mastication and digestion. The nutritive value of the oyster is not very great, but its delicacy of flavor and ease of digestion make it of great value to all, and especially to the sick. The raw oyster is probably more easily digested than the cooked.

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The crab and lobster are of considerable nutritive value, though on account of price they are used principally as delicacies.

Sausage. The food value of sausage depends upon the substances out of which it is prepared. If made from good meat it forms a very valuable preparation, as by this means all the small bits are collected and saved. But its method of preparation allows of the introduction of poor grades of flesh, and of several adulterations.

The adulterations which have been found in sausage are meal, to increase the bulk and the profit; salicylic acid and borax, to prevent decomposition; and a red coloring matter (fuchsin), to give the poorer quality of meat a better color. The liver sausage (leberwürste of the Germans) is made by grinding up liver, lungs, kidney, tendon, soft cartilage, and fat; sometimes meal is added. The so-called white sausage, which is used to some extent in this country, is made by mixing the crumbs of white bread with the meat. Blood or red sausage consists of a mixture of blood, fat, and flesh, with or without meal. Pea sausage is a well-known preparation in France, where it is patented and warranted not to become rancid. It is of variable composition, but consists principally of ground pease with meat, and some preservative, as salicylic acid. The writer does not know of its introduction into this country.

Sausage poisoning, which is common and so often fatal in parts of Germany, is fortunately very rare in this country, though a similar affection from canned and dried meats is becoming too frequent. The poison is generated by partial decomposition. Sausage which has a putrid odor, or rancid taste, or has greenish or yellow spots in its interior, should not be eaten. Bad sausage and other similar meat preparations are usually, in the interior at least, soft and sticky, and when broken show small cavities. This is true even when the outside appears to be all right.

Meat Extracts. Liebig's meat extract, which is now so well known, is made by boiling lean meat with from eight to ten times its volume of water, removing the insoluble parts, fat and albumen, and evaporating to the consistency of a syrup. About thirty pounds of meat yield one pound of extract. Meat extracts are made on the largest scale in South America from cattle which are wholly worthless for beef.

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It will be seen that this extract consists only of those constituents of the meat which are soluble in water, and they are certain crystallizable organic bodies and the inorganic salts. All the really nutritive parts of the meat are insoluble in water, and are not, therefore, present in the extract. Liebig's extract and similar preparations are agreeable in taste and odor, and are valuable stimulants, often improving the appetite, so that more valuable foods are demanded and digested. As stimulants, they are of great value to the sick; but some other food should also be supplied. A German deprived two dogs of all solid food, giving one only water and the other meat extract. The one furnished with the extract lost flesh more rapidly than the other, and died first.

Beef Tea. This should be prepared as follows: Cut the beefsteak into fine pieces. Put the chopped meat, *without any water*, into a small vessel, which is set into a kettle of warm water. Heat gradually, keeping the water in the kettle above blood-heat, but do not allow it to boil. Remove the small vessel containing the meat and the juice which has exuded from it, strain its contents, season, and serve.

As thus prepared, beef tea is somewhat more nutritious than Liebig's extract; still its chief value is to those who need a stimulant, and to those for whom a very small amount of food is sufficient.

Fluid Meats and Peptones. These are supposed to be formed by artificial digestion, whereby the same products are produced as in the stomach. The best of them are of value; others are worthless. They are to be regarded as medicines, and are to be used according to the directions of the physician.

Bone and Cartilage. Bone consists of a gelatine-forming organic substance, and of mineral salts. Besides, the marrow contains considerable fat and a little albumen. About one third of bone is organic matter, a large part of which is soluble in boiling water. For this reason bone is of value in making soups. The long bones are not acted upon by water readily, unless they first be cut or ground into small pieces. The bones of the spine and the ribs make a very nutritious soup, which yields as much as twenty-four per cent of the weight of the bone in solid matter.

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Bones should be boiled for several hours in order to get all the food-stuffs out of them. When we remember that these soups are also used for the purpose of serving vegetables, we may appreciate the real value of bone as a source of food.

MILK.*

Milk is a white, yellowish white, or bluish white fluid. It consists of a colorless fluid holding milk globules in suspension. These globules render the fluid opaque.

The reaction of fresh milk (cow's) is sometimes alkaline, sometimes acid; but, as a rule, it gives both reactions, turning blue litmus paper red, and red litmus, blue.

Composition. Milk contains representatives of all the classes of food. The albuminous constituents are casein and albumen. The former is coagulated when the milk becomes sour, or on the addition of an acid, or by the action of rennet. The albumen is precipitated by heat. The amount of casein is much larger than that of albumen. There is also a nitrogenous constituent which is not coagulated by either heat or acids.

The fat of milk forms butter, and the importance of this constituent is so great that we often decide as to the value of a given sample of milk from the amount of butter which it yields.

Milk sugar has the same chemical composition as cane sugar, but they differ somewhat in their physical properties.

If some milk be evaporated to dryness and the residue be burned, there remains a flaky, white ash, which contains all the inorganic salts which are absolutely necessary to the body.

The following table gives the average per cent composition of milk: —

Water.	Casein and Albumen.	Fat.	Milk Sugar.	Ash.
87.5	3.5	3.5	4.8	0.7

Colostrum. The fluid which the cow yields directly after calving is known as colostrum, which differs essentially in composition from milk, and is unfit for human food. It gradually, however, approximates milk, and the change may be regarded as

* As cow's milk is the only kind that is used as a commercial food in this country, all the statements made will refer to this kind unless some other kind be specified.

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complete by the eighth or tenth day. The fat of colostrum is in large lumps, and it contains much more albumen than milk does. Its average composition is shown by the following figures: —

Water.	Albumen and Casein.	Fat.	Milk Sugar.	Ash.
73.07	19.21	3.54	3.00	1.18

The Care of Milk. Milk should not be allowed to stand in copper, brass, or zinc vessels, nor in earthen vessels which are lined with lead glazing; for if the milk should become at all sour traces of the metal may be dissolved in it. There is no objection to wooden vessels if they are kept scrupulously clean; but when emptied, they should be scalded with boiling water, and then dried before they are refilled. There are also no objections to the best glazed earthen or to well tinned vessels.

Milk should not be allowed to stand uncovered in an occupied room, especially in a sitting-room or bedroom. The fluid rapidly absorbs gases, which may set up putrefactive changes in it. Besides, the dust which falls into it may contain disease germs, and these, finding a suitable place for their development, may multiply rapidly. There can be no question that milk has often served as the vehicle for distributing the germs of scarlet fever and diphtheria, which have fallen into it, or have been introduced with the water which has been used in diluting the milk, or for washing the vessels in which it is carried.

Souring of Milk. This fluid, on standing, sooner or later becomes distinctly sour, and its casein is coagulated. This is due to the action of a ferment, which is always present in the milk, on the milk sugar, which is converted into lactic acid. The coagulated casein is known as "clabber," and the fluid portion forms whey. The best method of retarding the souring process in milk consists in keeping it in a cool place. Boiling has a similar effect but it alters the nature of the fluid more or less. Milkmen sometimes add bicarbonate of soda to milk to prevent its souring. The alkali simply neutralizes the acid as fast as it is formed.

Adulterations. While a great deal that is sensational has been said about the adulterations of milk, these frauds are perpetrated too frequently. A food which forms the principal, and in many

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instances the sole, sustenance of children, should be kept free from any adulteration which in any way lessens its nutritive value. To furnish a child with watered milk is often to slowly starve it to death, and the person guilty of such an act should be treated as a criminal.

The adulterations practiced in the sale of milk are as follows: — 1. The addition of water; 2. The removal of more or less of the cream; 3. The addition of some foreign solid substance to increase the opacity or density of the fluid.

The addition of water is the fraud most commonly practiced. The amount added varies from ten to fifty per cent of the milk, though the former figure is probably the one most frequently approximated. Several states have laws defining the amount of milk solids which must be present. Wherever these laws are enforced they form a valuable protection to the consumer, and to honest dairymen as well. Unfortunately, there is no ready test capable of being used by any one, by which the exact amount of water can be determined. The amount of cream which forms on a given volume of milk standing in a tall glass tube or other vessel is a rough but valuable method which every housewife may employ. From this she cannot say with certainty to her milkman that he has watered his milk, but she can tell him that the milk is not as rich as it should be.

However, it must be remembered that the cream rises on milk much quicker under some conditions than under others. Watery milk may be produced by feeding cows upon sloppy food, such as the refuse from breweries, as well as by the direct addition of water. Besides, watery milk often has a bluish color, and is not as opaque as healthy milk; though this appearance is sometimes hidden by the addition of a yellow coloring substance, annatto.

Skimmed milk is frequently sold for whole milk. In certain states there are very excellent laws against such a practice. The same rough test may be made as given above for watered milk. Sometimes skimmed milk is added to an unskimmed portion, and then sold as whole milk.

The addition of foreign solids is not frequently resorted to. The most common substance used is bicarbonate of soda for the purpose of preventing the souring of the milk, as has already been

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stated. In the amount used it does not affect the food value of the milk. It is frequently said that chalk, gypsum, and gum arabic are added to milk. They may be used occasionally, but stupid indeed must be the consumer who would not detect these substances, which, on account of their insolubility, would be deposited in the vessel. It has also been stated that the brains of calves and other animals are pulverized or ground fine, and placed in milk. This is an adulteration found in sensational books, but not in milk.

Diseased Milk. There can be no question about the possibility of the transmission of certain diseases from the lower animal to man through the use of milk as a food. In inflammation of the udder, the secretion of the gland is diminished, and the act of milking causes the animal much pain. The milk is of unpleasant odor, and contains lumps of coagulated casein and albumen, and sometimes blood and pus. Such milk may cause irritation and even inflammation of the stomach in children. In all acute febrile diseases of cows the amount of the secretion is diminished, and in severe fevers the flow of milk ceases altogether. In chronic diseases, as those of the digestive organs, the milk becomes thin and watery.

The cause of the disease known as milk-sickness, which has prevailed in certain parts of Illinois, Indiana, Kentucky, Tennessee, Georgia, and some other states, has never been ascertained. Some ascribe it to plants which the cows eat; others are equally certain that the drinking water is the source. As the country becomes more improved, the disease appears less frequently. This would lead us to suppose that the poison is obtained from some native plant which is destroyed by cultivation of the soil.

Unfortunately, in many diseases of cows, during the first stages at least, the changes in the character of the milk are not sufficiently marked to be observed; however, the following kinds of milk should be avoided: —

1. Milk which becomes sour and curdles within a few hours after it has been drawn, and before any cream forms on its surface. This is known in some sections as "curdly" milk, and it comes from cows with certain inflammatory affections of the

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udder, or with digestive diseases, or from those which have been overdriven or worried.

2. "Bitter-sweet milk" is that whose cream has a bitter taste, is covered with "blisters," and frequently with a fine mold. Butter and cheese made from such milk cannot be eaten on account of the disagreeable taste.

3. "Slimy milk" can be drawn out into fine ropy fibers. It has an unpleasant taste, which is most marked in the cream. The causes which lead to the secretion of this milk are not known.

4. "Blue milk" is characterized by the appearance on its surface, eighteen or twenty hours after it is drawn, of small indigo-blue spots, which rapidly enlarge until the whole surface is covered with a blue film. If the milk be allowed to stand for a few days, the blue is converted into a greenish or reddish color. This coloration of the milk is due to the growth of a microscopic organism. The butter made from "blue milk" is dirty white in color, gelatinous in consistency, and bitter in taste.

5. "Barnyard milk" is a term used to designate milk taken from unclean animals, or those which have been kept in filthy, unventilated stables. The milk absorbs and carries the odors, which are often plainly perceptible. Such milk may not be poisonous, but it is repulsive.

The Value of Milk as a Food. The importance of this article of diet can hardly be overestimated. For children, it is the mainstay. For adults, it is a substance palatable and easily digested. About two quarts of good rich milk per day will support life, even if no other food be taken. One sick with a wasting disease, such as typhoid fever, has his chances of recovery greatly increased if he takes milk with comfort and digests it with ease. For the infant, there is no other food which can fully supplant the milk of the mother. Physicians of large experience say that the chances of rearing a babe are 50 per cent better when it is well supplied with healthy milk by its mother than when nourished by artificial preparations. Woman's milk contains less fat and casein, and more sugar than the cow's milk. When it becomes absolutely necessary to substitute the latter for the former, the cow's milk should be diluted with one third its volume of warm water, and one half ounce of milk sugar should be added

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to each pint. As the child grows older, the amount of water added should be diminished, until, at the age of six months, undiluted cow's milk may be used.

Condensed Milk. This is prepared by evaporating milk in a vacuum to one fifth its volume, or to the consistency of honey, placing it in cans, which are set in water, the temperature of which is raised to the boiling point when the cans are sealed. Sometimes cane sugar is added after evaporation. When used, condensed milk is diluted with five times its volume of warm water. It forms a valuable substitute for fresh milk when the latter cannot be obtained. Its exact value will depend upon the quality of the milk used in its preparation. The three most prominent brands of this preparation used in this country are the Anchor, the Swiss, and the Anglo-Swiss. The writer has examined these and found them all of good quality.

BUTTER.

Of all the fats, butter is the most palatable and most easily digested. Only when it is rancid does it lead to dyspepsia. It, like all other fats, should be taken in a finely divided state. Its food value is great, and the amount consumed per head daily is about one ounce.

Physical Properties. Good butter is of a pale yellow color, which is uniformly diffused through it. The exact color of butter varies with the food of the cow; but as a yellow butter is universally demanded in market, makers almost invariably use a preparation of annatto. This artificial coloration has been so long practiced, and as the use of the coloring material is not detrimental to health, it may be regarded as a legitimate use. Good butter is free from rancid taste and odor. White lumps in butter are due to the coagulation of casein, from the milk becoming too acid, and its incorporation with the cream. When a watery fluid exudes from the freshly cut surface of butter, it is evidence that the buttermilk was not expressed as thoroughly as it should have been, or that water has been added for the purpose of increasing the weight.

Composition. The amount of water in butter will depend upon the manner of preparation and the quantity of salt added. In

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some families, an unsalted butter is used. This does not contain more than from 3 to 6 per cent of water. But as a rule, more or less salt is added in making the butter. This is done to insure the preservation of the fat, and most people consider such an addition an improvement to the taste. Good salted butter will not contain more than from 10 to 15 per cent of water, while the poorer grades may contain as much as 28 per cent. This large amount is taken up only when boiling water is mixed with the fat, and then the whole allowed to cool.

The salt used in butter should be finely pulverized and thoroughly mixed with the fat. From 3 to 5 per cent of salt is all that is needed for preservation, but in order to increase the weight, from 10 to 15 per cent is sometimes added. Good butter contains from 85 to 90 per cent of fat, and any which contains less than 82 per cent may be considered as adulterated. The most common fraud in regard to the fat consists in the use of tallow and lard, which will be discussed under the heads of oleomargarine and butterine.

The greatest amount of casein permissible in butter is 2 per cent. If there be much more present the butter is lumpy. There is now being sold to dairymen a recipe by which it is guaranteed that a given volume of milk will be made to yield 25 per cent more of butter. The process consists in the coagulation of all the casein in the milk, and its incorporation with the fat. The product is really not butter at all, but an inferior soft cheese. An excess of casein in butter increases its liability to become rancid.

How to Take Care of Butter. Butter, like milk, takes up unpleasant odors; for this reason it should not be allowed to stand exposed to the air of occupied rooms, nor in other places that may become foul. When freely exposed to air, butter becomes rancid: it should be tightly packed and covered. Warmth hastens rancidity: it should be kept in a cool place.

OLEOMARGARINE AND BUTTERINE.

Oleomargarine. This substance is now largely manufactured and sold in this country, generally under the name of butter, but sometimes under its proper name. It is made as follows: The best beef fat is cut from the carcass while it is still warm. All

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bloody portions and those tainted in any other way are rejected. The selected fat is placed in fresh cold water, in which it is both cooled and washed. It is then ground like sausage. Then it is heated from 160° to 180° Fahr., by which the oil is separated from the membranes. The oil, after being salted, is cooled, and then pressed. Then it is placed in milk, a preparation of annatto added, and the whole churned, when it is worked as butter. The temperature at which the oil is separated from the membrane should be as low as possible; but in practice it varies within large limits. Some manufacturers use a heat of only 120°, while others allow the temperature to run up to 200° Fahr. The oil thus prepared is known to the trade as "butter oil."

Butterine. This is prepared by the mixture of "butter oil" obtained from beef fat, as in making oleomargarine, and a similar oil obtained from hog fat, and churning with milk. The oil from the lard is separated at a temperature not exceeding 120° Fahr.

A great deal has been said against the use of these preparations as foods. Several states have laws which require that when such articles are sold, the buyer shall receive them from a vessel which is labeled with the word Oleomargarine or Butterine, as the case may be, in letters one inch high, and the portion taken by the buyer shall be covered with a paper which also bears the true name of the fat. This law is certainly a just one, as every article of food should be sold under its proper name; and the price of good butter should not be demanded for these imitations. At least two states — New York and Michigan — have enactments which wholly forbid the manufacture and sale of these preparations. These laws are both unwise and unjust. Oleomargarine and butterine are valuable food-stuffs. They are not equal to the best grades of butter, but are far superior to the poor, partly rancid butter which is so generally sold in the large cities. As has been seen from the methods of preparation given above, only the very best pieces of fat can be used. Any fat which has an unpleasant odor, or is in the least degree foul, must be rejected, for there is no method known for removing the odor.

One of the greatest dietary needs of the workingman is a sufficient supply of an inexpensive, wholesome fat. This will be largely met by these artificial butters.

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CHEESE.

Cheese is of considerable nutritive value, one pound containing as much nitrogen as two pounds of meat, and as much fat as three pounds of meat; but, as a rule, cheese is difficult of digestion, and can be taken only in small amount at a time. Moreover, the exact composition of cheese is quite variable. It is made both from whole and skimmed milk, and at present some is made from skimmed milk to which oleomargarine or butterine has been added. The dairyman skims his milk, making butter from the cream; then to the skimmed milk he adds the fatty preparation and makes cheese. In this way the same milk is made to produce both butter and cheese. It is a popular idea, that while cheese itself is digested with difficulty, a small amount of it in the stomach aids the digestion of other substances. The experiments of Dr. Edward Smith have confirmed this belief. As digestion is partly due to fermentation, and since cheese contains certain ferments, the belief is not irrational; but when taken as an aid to digestion, the amount should be very small, not more than from one half to one ounce.

True cream cheese is made from whole milk, to which cream has been added; but what is ordinarily known as "cream cheese" is that made from unskimmed milk. In such a cheese the proportional amounts of casein and fat are substantially the same as in good milk. Skimmed milk cheese is not so nutritious and not so easy of digestion as that made from whole milk.

Cheese is almost universally colored with annatto, which, as it has been so long used and is not detrimental to health, may be regarded as a justifiable adulteration. Without it cheese would be of a dingy white color.

EGGS.

There is no bird whose eggs may not be eaten in case of necessity. However, the eggs of flesh-eating birds are of strong, unpleasant odor. Practically, our use of eggs as food is confined to those of the chicken, duck, Guinea hen, and goose. The exact taste of eggs is influenced largely by the food of the bird. The nutritive value of eggs is great, both on account of their chemi-

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cal composition and their flavor. The average weight of hens' eggs is from 1½ to 2 ounces, the parts existing in the following proportions: —

Shell	11.5 per cent.
Albumen (white)	58.5 "
Yolk	30.0 "

The white of the egg consists of water and albumen, with traces of inorganic salts and fat. The yolk contains from 30 to 32 per cent of fat; so that, practically speaking, the fat is confined to the yolk. There is not much difference in the time required for the digestion of a raw egg and one which has its albumen coagulated by heat, but the latter is the more agreeable in flavor. A hard-boiled egg is digested with more difficulty than one rarely done.

Since eggs are most abundant and consequently cheapest during spring and summer, their preservation is of considerable importance. When left exposed to the air, germs pass through the shell and cause decomposition. Consequently, the object to be held in view in endeavoring to preserve them is to exclude the air. This may be done by placing them in lime-water; but in this way the shells are made very brittle, and many are broken in removing them. They may be dipped in mucilage and then packed in salt. However, the most common method consists simply in packing them in salt alone, or in salt and lime. Some dip the eggs for a moment in boiling water, whereby the part of the white immediately in contact with the shell is coagulated.

Decomposed eggs will float in brine (made by dissolving one part salt in ten parts of water), while fresh eggs placed in the same solution will sink.

Vegetable Foods.

CEREALS AND GRAINS.

The cereals used as food in this country are wheat, rye, oats, corn, and rice. The most important food constituents of the grains are starch, proteids or nitrogenous substances, and the

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phosphates of the ash. They also contain small amounts of fat, sugar, gum, and mineral substances other than the phosphates.

Of all the grains, wheat is considered the most nutritious. Its exact composition varies slightly, according to climate, nature of the soil, and the fertilization employed. Its average per cent composition is given in the following figures: —

Water.	Proteids.	Fat.	Sugar.	Starch.	Cellulose.	Ash.
13.56	12.42	1.70	1.44	64.07	2.66	1.79

The nitrogenous substances consist of vegetable albumen, casein, and gluten. The last mentioned forms by far the greater part of the nitrogenous material. The ash may contain as much as 45 per cent of phosphoric acid, which is combined with lime, magnesia, and potash. As a rule, the greater the amount of phosphoric acid in the ash of the wheat, the greater the amount of nitrogenous matter in the grain.

Rye does not differ greatly in its composition from wheat, as is shown by the following figures, which give the average of forty-four analyses collected by König: —

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
15.26	11.43	1.71	0.95	4.88	61.99	2.01	1.77

However, the gluten of wheat is superior in quality to that of rye. In those countries whose inhabitants are compelled to depend largely upon rye bread, there is much suffering at times from poisoning with ergot. Fortunately, this poison is not found to any extent in wheat.

Oatmeal, which has been used as a food in Scotland for a long time, is now being largely consumed in the United States, and it is to be hoped that its use will become more universal. It is a highly nutritious, healthy, and cheap article of diet. The average composition of the grain is as follows: —

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
12.37	10.41	5.23	1.91	1.79	54.08	11.19	3.02

It will be noticed that the amount of fat is much larger than in wheat or rye. In the best specimens of the grain the fat may be as much as 8 per cent.

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Corn is largely used in some of the southern states, and, in the various ways in which the people know so well how to prepare it, it forms a most valuable food. The exact composition varies considerably with the variety of the plant and the soil on which it grows, but the following are the average figures: —

Water.	Proteids.	Fat.	Sugar.	Gum.	Starch.	Cellulose.	Ash.
13.12	9.85	4.62	2.46	3.38	62.57	2.49	1.51

The greater part of the nitrogenous material consists of vegetable fibrine.

Rice grains have the following average composition: —

Water.	Proteids.	Fat.	Starch.	Gum.	Cellulose.	Ash.
9.55	5.87	1.84	73.00	2.85	5.80	1.09

Since the per cents of both proteids and fats are low, it must be regarded as the least nutritious of the grains here mentioned. However, its ease of digestion renders it valuable to the sick, and the fact that its heat-producing power is not so great as the other grains, adapts it to the inhabitants of warm countries.

Barley, which is so largely used by the Scandinavians, and millet, which is a staple food in India and some other warm countries, are so seldom used in this country as foods that an extended notice of them is unnecessary.

Buckwheat does not belong to the cereals, but to a wholly different class. However, as it is a food which is highly prized by many, it deserves mention. The plant soon reaches maturity, and may be grown upon poor, sandy soil, as well as upon richer ground. The average composition is shown by the following figures: —

Water.	Proteids.	Fat.	Gum.	Starch.	Cellulose.	Ash.
12.63	10.19	1.28	2.85	69.30	1.51	2.24

The albuminous substances found in buckwheat differ materially from those present in the cereals. Its food value is not so great as that of wheat, rye, or oats.

FLOUR AND MEAL.

By grinding, the grains which have been described are converted into flour or meal. By this process the food material is

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better fitted for cooking, and is to some extent separated from the indigestible portions. A few simple rules will be given by which good flour or meal may be distinguished from the inferior grades: —

1. Good wheat flour is white, with only a faint yellow tint. It does not contain any bluish, grayish, or dark specks. It feels soft and dry to the finger, and when some is pressed in the closed hand it forms a dry lump, which breaks down readily with the gentlest pressure. If it fails to form a lump when pressed in the hand, it contains too much bran, or some mineral adulteration has been added. When the finger is introduced vertically into good flour, the depression thus made remains; otherwise, there is too much bran present. The odor is fresh and pleasant, not musty. Neither with the unaided eye nor with a magnifying glass will any living bodies be found in good flour.

2. Rye flour has a grayish tint, and a characteristic odor and taste. The other general properties are identical with those of wheat flour.

3. The color of corn meal varies with the variety of corn from which it is prepared. It should feel perfectly dry and powdery. It does not "lump" when pressed in the hand, and it has a characteristic, pleasant odor. Corn meal, when decomposition has begun, has a rancid odor, and if some of it be placed upon a piece of moistened blue litmus paper (which can be obtained at any drug store), the color of the paper will be changed to red. Good meal has no effect on the color of litmus paper.

4. Oatmeal should be dry and free from any disagreeable odor.

The Care of Meal and Flour. When exposed to the air, flour and meal absorb water, and this greatly increases their tendency to decompose. In moist flour the lower forms of life are likely to develop. For these reasons these preparations should be kept in well closed receptacles.

Adulteration. Fortunately, these foods are very rarely adulterated in this country. Since wires have been used so extensively for binding in the great wheat fields of the northwest, a small amount of iron is found in flour, as an accidental adulteration. It is frequently stated that gypsum and other mineral substances are added to flour, but the writer has examined many hundred

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samples, and has never detected such an adulteration. It has also been stated that the so-called "patent flour" contains alum. This is certainly false. One of the writer's students examined twenty-three samples of "patent flour" obtained at different places and failed to find any alum present. It may be possible that in some instances the cheaper flours or meals are added to wheat flour; but even this fraud, if practiced at all in this country, is carried on to a very limited extent. The great abundance and low price of wheat would tend to make any adulteration profitless.

BREAD.

The cooking of his food is one of the earliest evidences of man's civilization, and with no other food has the process of cooking been so thoroughly developed as with the products obtained from the edible grains. The essential constituents of bread are flour, water, and salt. To these have been added, for the purpose of varying and improving the taste, one or more of the following substances: Milk, sugar, eggs, fats, ethereal oils, and fruits. Civilized man in every part of the world employs some means of raising or leavening his bread. By this, the taste is improved, and the crumb, being divided by the evolved gas, is more readily acted upon by the digestive juices. The methods of raising bread are as follows: —

1. *By the Growth of Yeast.* Yeast consists of microscopic vegetable organisms, which, when placed in a suitable medium, grow rapidly, producing alcohol and carbonic acid gas. The evolved gas, in attempting to rise, becomes entangled in the meshes of the dough, distending it and making it light. After the dough has risen sufficiently, it is placed in a hot oven to bake. The heat destroys the yeast plant, and thus prevents further fermentation. If the growth of the yeast be allowed to continue for too long a time, acetic, lactic, and butyric acids are formed, and such dough makes "sour bread."

2. *By Baking Powders.* In the use of baking powders, the carbonic acid gas, necessary to render the dough light, is generated by chemical means. Baking powders consist of some alkaline carbonate, as sodium bicarbonate, and some acid substance, such as the acid tartrate of potash (cream of tartar), together with

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a small amount of starch to keep the mixture dry. As long as the powder is perfectly dry, no reaction occurs; but when it is dissolved in water in the dough, the acid acts upon the carbonate, liberating carbonic acid, which has the same effect in raising the dough as when it is produced by the growth of the yeast plant.

In baking powders, ammonium carbonate is sometimes used instead of sodium bicarbonate, and the acid tartrate may be replaced by the acid phosphate of lime. But the use of alum in baking powders is an adulteration which is injurious to health. It unites with the phosphates in the bread, rendering them insoluble, and preventing their digestion and absorption. In this way alum, when present, diminishes the nutritive value of bread.

A small amount of starch in baking powders is necessary to keep them dry, but too often the manufacturer adds as much starch as possible, and this should be considered as an adulteration.

3. *By Aeration.* In some large bakeries, carbonic acid gas, generated by the action of some acid on carbonate of lime, is forced under pressure into the dough, thus distending the mass; or the dough is kneaded with water which has been saturated with carbonic acid under pressure. When the gas is washed before being forced into the dough or water, this method is a very desirable one; but the cost and care of the special apparatus necessary will prevent the adoption of this method of raising bread, except in large bakeries and hotels.

General Properties of Good Bread. The general statements concerning bread refer to that made from wheat flour. Good bread has a thick, fragile crust, which is not burnt, and which forms from 25 to 30 per cent of the weight of the loaf. The crumb is white and filled with cavities, the partitions between which are easily broken down. These cavities should be distributed through every part of the crumb; otherwise the bread is sodden and heavy, and decomposes quickly. The bread should be of a pleasant odor and taste. If the bread is acid, it was probably made from inferior flour.

Changes on Standing. On standing, bread gradually loses weight by the evaporation of a part of its contained water, and becomes hard. The amount of water given off in a certain time

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will depend upon the size of the loaf and the nature and extent of the crust. Bread should not lose more than 3 per cent of its original weight after four days. Stale bread, when dipped in water and rebaked, or when steamed, becomes palatable, but never completely regains the properties of fresh bread. In stale bread, small living organisms are likely to develop. Some of them are poisonous. The white and orange-yellow molds which form on stale bread are due to a poisonous growth. Sometimes blood-red spots appear in bread. These also are due to a microscopic growth.

Adulterations of Bread. Bread is not adulterated to any great extent in this country. The baker's loaf is usually of light weight. An excess of water is often incorporated with the dough. This makes the bread sodden and heavy, and increases its liability to decompose. In some of the larger cities mashed potato has been found worked into bread. This lowers the nutritive value of the article greatly. Alum is sometimes added directly to flour or dough, and is sometimes contained in the baking powder, as has been stated.

The Food Value of Bread. As has been remarked, the most important food constituents of the grains, and consequently of bread, are the proteids, starches, and ash. The amount of nitrogenous matter is too small for a perfect food, and for this reason bread is often taken with some other food richer in nitrogen, such as meat. Bread is also deficient in fat, and man instinctively takes some kind of fat, such as butter or bacon, along with his bread. Notwithstanding these imperfections, bread is a food of which we never tire, and the various ways in which it is prepared aid in sharpening the appetite. Besides, while some important food substances are not abundant in bread, all are present to a greater or less extent; and with the addition of a little more nitrogen in the shape of meat and fat, as butter or bacon, a perfect diet is secured.

PEASE AND BEANS.

Pease and beans belong to the leguminous seeds. They contain more nitrogenous matter or proteids than any other vegetable food. Not only is the amount of proteid greater than in wheat

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and other grains, but it is different in its properties. That of the grains is principally gluten, while that of pease and beans belong to the casein group. The former is more easily digested than the latter, pease and beans often causing disturbances in the stomach and bowels. The average composition of these foods is shown by the following figures: —

PEASE.

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
14.99	24.04	1.61	49.01	7.09	3.26

BEANS.

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
14.76	24.27	1.61	49.01	7.09	3.26

There is great difference between the digestibility in these substances in the green and in the dried state. Soft green pease tax the stomach but slightly. Dried pease and beans must be boiled slowly and for a long time; and if they are very old, they should be soaked for several hours, and then crushed before they are cooked. Hard water is to be avoided in cooking them, as the lime of the water forms an insoluble compound with the albuminous constituents of the seeds.

Ground pease and beans are used to some extent in this country. They form a part of some food preparations, such as pea-sausage (erbswürste of the Germans).

Food Value of Pease and Beans. The nutritive value of the seeds is considerable, but on account of the tax which they impose upon the digestive organs, they cannot be taken in large quantities. The deficiency of fat is usually supplied by serving these foods with bacon or other fatty food.

POTATOES.

Potatoes contain only about 25 per cent of solids, four and five tenths of which is starch. The per cent of nitrogenous matter and fat is small, as shown by the following figures which give the average per cent composition of potatoes: —

Water.	Proteids.	Fat.	Starch.	Cellulose.	Ash.
75.77	1.79	0.16	20.56	0.75	0.97

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Notwithstanding its comparatively small per cent of solids, the potato will continue to be one of the most valuable foods. Its growth is not influenced by soil and climate to such an extent as that of the cereals. The yield of the potato per acre is greater than that of any other vegetable. It is preserved with ease for winter's use, and the raw material is fitted for the table with but little trouble and expense. It can be served in a great variety of ways, and with other foods. Its deficiency in nitrogenous matter and fat is made up by cooking it with meat. It is agreeable to the taste, and easy of digestion. New potatoes are said to be waxy, and not so easily digested as old, mealy ones. In order to retain the salts, potatoes should be cooked with their skins on. If boiled, they should at once be placed in hot water. If baked, the oven must be moderately hot.

Potatoes should be of fair size, firm, and free from mold. The sweet potato is similar in composition to the ordinary potato, and furnishes an agreeable substitute; but it is more expensive and cannot be preserved so easily.

OTHER VEGETABLES.

The other succulent vegetables which are used as foods are principally useful on account of furnishing variety, and for the acid salts which they contain, and whose use renders other foods more digestible and prevents scurvy and kindred affections.

The beet root is not only a pleasant food, but furnishes as much as 10 per cent of sugar, for which it is now largely grown; though the different varieties of the root vary considerably in the amount of sugar which they contain.

Turnips, carrots, and parsnips contain from 82 to 90 per cent of water, from 5 to 10 per cent of starch, from 2 to 6 per cent of sugar, about 1 per cent each of nitrogenous matter and salts, and ½ per cent or less of fat.

Cabbage, turnip tops, spinach, water-cresses, dandelion, and other "greens" should always be thoroughly cooked. The amount of absorbable food which they contain is generally less than 5 per cent.

The tomato, either raw or cooked, furnishes an agreeable sauce. It is also used for making soup, and for flavoring meat

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soups. It contains over 92 per cent of water, less than 2 per cent of starch, and about 2½ per cent of sugar.

Rhubarb is a pleasant, acid vegetable, which is especially serviceable on account of its being one of the earliest of spring plants.

Pumpkins and squash contain from 1 to 5 per cent of starch, about 1 per cent of sugar, and less than 1 per cent each of nitrogenous matter, fat, and ash.

Thoroughly ripe melons are beneficial in season, on account of their action upon the kidneys. They should never be eaten, however, unless they are thoroughly ripe and of good quality.

STARCHES.

The food value of the starches is small, but they are easy of digestion, and are serviceable in preparing dishes for the sick. When mixed with nitrogenous and fatty substances they are largely used in making puddings. In this way, stale bread and other remnants from the table may be converted into palatable dishes.

Sago and arrow-root are obtained from various palms. The former appears in small granular masses, which, when dry, are so hard that they can hardly be crushed by the teeth; but they readily absorb water and soften.

Arrow-root, when pure, is found in perfectly white lumps, which may readily be crushed between the fingers. When boiled with water and constantly stirred, no foam should form on the surface. The presence of a foam indicates that the arrow-root has been adulterated with flour.

Tapioca, obtained from various tropical plants, and corn and potato starches are also used in puddings.

SUGARS.

Sugar is a name now given to a class of substances which vary among themselves to some extent both in physical and chemical properties, though ordinarily the term "sugar" is supposed to refer to that obtained from the sugar cane and sugar beet. Practically there are now in trade three kinds of sugar, — cane sugar (obtained from the cane and beet), glucose or grape sugar (ob-

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tained by the action of dilute acids on starch), and "mixed sugars," or "new process sugars" (consisting of cane and grape sugar mixed in various proportions). Cane sugar is here referred to, unless some other is specifically mentioned.

Sugar is used for modifying the taste of other foods, and for the manufacture of confectionery and syrups. By improving the taste, sugar, when added in proper amounts, aids the digestion of other substances, and furnishes a certain amount of nutriment in itself.

Good, crystalline, white sugar contains less than one half of 1 per cent of water, and not more than this amount of ash. Yellow sugar may contain as much as 2 per cent of water.

Grape sugar may contain from 10 to 25 per cent of water, and from ½ to 2 per cent of ash.

Much has been said about the adulteration of sugar with glucose. That this has been practiced to a considerable extent is shown by numerous analyses. Indeed, "mixed sugars" are sold by wholesale dealers, and too frequently the retail grocery-man sells these to his customers as straight cane sugars.

Experts can recognize these sugars by the way they "handle." "They are apt to cake and harden, and stick to the scoop and sides of the barrel. In the white, granulated sugars, the mixture of the white lumps of glucose with the crystalline cane sugar can be readily seen; but in the brown sugars it is difficult to detect the fraud by the appearance of the sugar. When a mixed sugar is shaken with cold water, the white lumps of the glucose will remain undissolved for some time after all the cane sugar has passed into solution."

Glucose, when made with care — and it must be so made when it is used to adulterate sugar — is not harmful to health. The fraud is a pecuniary one, as glucose costs usually less than two cents per pound, but when mixed with sugar, it is sold for six cents and more per pound. The sweetening properties of glucose are not so great as those of cane sugar, and consequently, in the preparation of foods, much more of the mixed sugar is required than would be necessary with cane sugar.

Confectionery. The various candies are made from sugar, or sugar and starch, with or without coloring matters. Twenty-

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seven samples were examined under the writer's direction, in order to ascertain whether or not they contained any poisonous substance. One sample consisted wholly of starch, terra alba, and an aniline color, without any sugar. The use of terra alba (white earth or clay) in any considerable amount would be harmful on account of its indigestibility. Only two samples contained ultra marine as a coloring agent. This would also be harmful, if used in large quantity. The other samples were all free from any suspicious ingredient. The coloring agent most frequently used is aniline. Grape sugar is extensively employed in the manufacture of confectionery.

Honey. This is frequently adulterated with glucose, which may be added directly to strained honey, or may be fed to the bees, and by them deposited in the comb. Unadulterated honey varies in flavor according to the plant from which it is gathered. White clover and buckwheat honeys are much prized in this country. The fact that honey sometimes produces unpleasant symptoms is probably due to bees feeding upon poisonous flowers, though the susceptibility of the individual partaking of it probably plays an important part. Pollen grains are often mixed with honey, and the unpleasant effects upon the system may be, in part at least, due to these.

Molasses and Syrups. These are solutions of sugar, and they are now frequently made by a mixture of cane syrup and glucose. Indeed, many prefer a syrup containing glucose. It is not so sweet as a pure cane sugar molasses. However, the former should be much cheaper than the latter. As in the case of sugar, the fraud here practiced is a pecuniary one rather than one detrimental to health.

FRUITS.

Fruits abound in tropical and temperate climates, and furnish a great variety of flavors, which are useful in themselves and for the purpose of rendering other foods more enjoyable. The real food value of fruits, judged by their chemical composition, is small, but when thoroughly ripe and well preserved, they act beneficially upon the system, improving the appetite, and maintaining a healthy condition of the various vital organs. Probably

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no fruit is necessary to life, and fruits may be regarded as luxuries; but man's instinct and cravings prompt him to obtain them often, even when their cost is considerable. Undoubtedly they are most highly prized by the inhabitants of warm countries, where foods that produce but little heat are most desirable. The most enjoyable part of fruits is their juice, which consists principally of watery solutions of sugar and acids. The amount of sugar in fruits varies from 1 to 18 per cent. The cellular parts are not easily digested, and those fruits are prized most highly which have the greatest quantity of juice with the smallest proportion of cell structure.

The majority of fruits may be eaten either raw or cooked, and those which cannot be preserved in their natural condition may be dried. Therefore, in one or the other form they may be enjoyed at any season of the year, and may be served with other foods.

The volatile ethers, upon which the flavor of many fruits depends, have been made artificially by the chemist, and, under the name of essences, are largely used in cooking.

It is wholly unnecessary even to mention the various fruits in use, as all are sufficiently acquainted with their general properties and composition. Suffice it to say, that thoroughly ripe fruit, taken in moderation, can have no deleterious effect upon the system. However, care should be exercised in using fruits imported from countries in which an infectious disease, such as cholera, prevails. Such fruit should at least be thoroughly washed, or stripped of its covering, and, if suitable for such purpose, should be cooked.

Canned Fruits. In buying canned fruits, it should be observed that the ends of the cans are concave. If convex, there has probably been some decomposition of the contents with the evolution of gas. Cases of severe poisoning have followed the eating of partially decomposed canned fruits. Moreover, if the cans appear old and battered, thus giving evidence of having been used twice or oftener for the purpose of preserving fruit, they should be rejected, since the contents of such cans are liable to contain small amounts of tin or other metal, which may prove poisonous. Much having been said about the use of salicylic

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acid in canned fruits as a preservative agent, the writer requested one of his students to examine samples from all the more prominent firms engaged in the preparation of canned foods, for this adulteration. In no case was the acid found. Frequently, agents pass through the country offering to sell preparations or recipes for the sure preservation of fruit. The active ingredient of all these formulas is salicylic acid or some form of sulphurous acid. The use of such preservatives is unnecessary. Moreover, they injure the taste of the fruit, and are liable to prove deleterious to the health of the consumer.

Prof. Sharpless states that "apple sauce" is frequently pumpkin boiled with cider; that the raspberry jam offered for sale is often sour; and that strawberry jam is frequently made from the refuse strawberries of the market.

NUTS.

Judging solely by chemical composition, nuts should be classed among the most nutritious foods. The following figures give the percentage composition of sweet almonds, walnuts, and hazelnuts, from numerous analyses collected by Kŏnig: —

	Water.	Proteids.	Fat.	Starch and Sugar.	Cellulose.	Ash.
Almonds	5.39	24.18	53.68	7.23	6.56	2.96
Walnuts	4.68	16.37	62.86	7.89	6.17	2.03
Hazelnuts	3.77	15.62	66.47	9.03	3.28	1.83

But nuts are not easily digested, and, with the exception of cocoanuts, do not form an important part of the food of any people. They may be regarded simply as luxuries, so far as their use in this country is concerned. Crushed acorns are used to some extent in the adulteration of ground coffee.

VEGETABLE OILS.

On account of our abundant supply of animal fats, the vegetable oils are not extensively used as foods in this country. The one best known is olive oil, which is used as a dressing for other foods. Olive oil, however, has been largely adulterated or supplanted by cotton-seed oil, large quantities of which are sold as olive oil.

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CONDIMENTS.

Condiments are substances whose employment in cooking is for the sole purpose of seasoning foods. However, at least one member of this class — common salt — is essential to healthy existence. Condiments improve the taste of foods, sharpen the appetite, and improve digestion. While much benefit arises from this use in small amounts, when taken in excess they may prove highly detrimental to health.

It is stated that certain tribes in the interior of Africa exchange gold for salt, ounce for ounce. This illustrates the great need of this substance felt by the animal system. We know that wild animals sometimes travel hundreds of miles in search of salt-licks. Experiments have been made in which two oxen were placed under exactly the same conditions, and furnished with the same food, save that salt was denied one, and given to the other. The one deprived of salt did not thrive as did the other.

The purity of salt is judged by its whiteness, fineness, dryness, and perfect solubility in water. The coarser kinds of salt contain compounds of lime and magnesium, are often dark in color, and absorb moisture from the atmosphere.

Vinegar is an acid fluid which may be produced by the fermentation of any solution containing sugar. Cider and wine vinegars are most highly prized, though the following varieties are now sold in this country: —

1. Cider vinegar, from apples and pears.
2. Wine vinegar, from grape juice and inferior wines.
3. Malt vinegar, from barley.
4. Beer vinegar, from sour ale or beer.
5. Glucose vinegar, from grape sugar.
6. Crab vinegar, from crab-apples.
7. Artificial vinegar, made with dilute solutions of the mineral acids, especially sulphuric acid.

The acidity of vinegar is nominally due to acetic acid. Sulphuric acid is sometimes added to increase the acidity. The British law allows this adulteration to the extent of one tenth of one per cent; but if the vinegar be properly prepared, such an addition is not necessary; and if any addition be allowed, the

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amount is likely to exceed that given above. Burnt sugar is sometimes added to vinegar to give it color.

The per cent of acetic acid should be at least 3. Of five samples recently examined, the smallest per cent was 3.2, and the greatest, 6.7. Only minute traces of mineral acids were found in three of these samples, while the other two were wholly free from such adulteration.

Table mustards are frequently diluted with tumeric, flour, or yellow lakes. Pepper is sometimes mixed with flour, bread, or starch. Spices are frequently adulterated with flour, starch, bread, and ground peanut shells. Cloves may contain arrow-root. In order to obtain spices pure, they should be purchased unground.

TEA.

Tea is the most extensively used and the least harmful of all beverages. Upon most persons it produces agreeable sensations. "It cheers, but does not inebriate." It relieves, to a certain extent at least, the feeling of bodily weariness, quickens the pulse, and deepens the respiration. Upon the nervous system it acts as a stimulant, and the excitation is not, as in the case of alcoholic drinks, followed by depression. Considerable discussion has been carried on over the question whether or not its use increases waste of tissue. This may now be considered as settled in the affirmative. Dr. E. Smith and others have repeatedly shown that the amount of waste matter in the air exhaled from the lungs is markedly increased. Tea, then, acts as a food principally by hastening the oxidation or burning of other substances in the body.

It creates a blast which burns up the half charred *debris* of the system, and from the burning or oxidation we receive increased energy. From what has been said, it will be evident that the only time when tea should be used is late in the day, after the heaviest meals have been taken. For the weak and debilitated, it is not suitable or should be used very sparingly. Its tendency to produce sleeplessness may also restrict its use.

So far as its chemical composition is concerned, tea contains but little of nutritive value. The high place of tea among foods is solely due to its effect upon the nervous system.

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In the market there are two kinds of tea — green and black. Until recently, it was supposed that these were products of different species, or at least of varieties of the tea plant; but it is now known that the two kinds arise from different methods of curing the leaves. In preparing green tea, the leaves are dried immediately; while in the other, the leaves are thrown into heaps, and a certain degree of fermentation or decomposition is allowed to take place before the drying is perfected.

The chief constituents of tea are its active principle called theine, which is identical with the active principle of coffee, a volatile oil, tannic acid, and a small amount of ordinary food substances.

Theine forms from 2 to 3 per cent of tea. In making tea as is ordinarily done, the greater part of the theine is dissolved out of the leaves, — tea yielding its active principle to water more readily than coffee. From equal weights, three times as much theine is obtained from tea as from coffee. According to the investigations of Mr. Fellows, 224 five-ounce cups of tea beverage are made from one pound of tea, and 45 eight-ounce cups from a pound of coffee. This makes the cost of an ordinary cup of tea, when the leaf sells at 75 cents per pound, about one third of a cent; and of a cup of coffee, when the berry sells at 27 cents per pound, about three fifths of a cent. In this estimation the sugar and milk added to these beverages are not considered.

The volatile oil of tea is the special stimulant, and the market value of a tea depends more upon this than any other constituent. The amount and quality of this substance present are judged by the odor as well as by the taste of the hot beverage. Large tea houses have experts who are called "tea tasters," and whose duties consist of deciding as to the value of different samples by the odor and taste. By virtue of the volatile oil, tea increases the flow of perspiration, and thus, although taken hot, may act as a cooling agent. The volatile oil is more abundant in green than in black tea.

Tannin is also more abundant in green than in black tea. The object in making tea should be to dissolve as little of the tannin as possible, and at the same time extract as much as possible of the theine and volatile oil. To accomplish this, tea should be steeped five or ten minutes, by no means longer than ten min-

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utes; but the water should be kept warm after that until the beverage is drawn for drinking. Mr. Fellows found the amount of tannin extracted from the best Japan tea, after steeping for five minutes, to be 0.10 per cent; after ten minutes, 0.98 per cent; after thirty minutes, 3.09 per cent. It is to the tannin that the astringent properties of tea are due, and when tea has been boiled it is so astringent that it is well-nigh unfit for use, and, indeed, may cause derangements of the digestive organs.

Tea contains small amounts of albuminous and starchy substances, but, as has been stated, these are present in such small amounts that they are not worthy of consideration.

Tea is subject to the following adulterations, which fortunately are not largely used at present: —

1. "Spent" leaves, those which have been once used for making tea, are dried and mixed with fresh leaves. This adulteration is not practiced extensively in this country.

2. The poorer varieties are mixed with the better, and the whole sold as of first quality.

3. Green tea is sometimes tinted with indigo and gypsum. Prussian blue is said also to be used, but the writer has failed to detect it after examining many samples. Black tea is also tinted with graphite. This is not used in large amounts, and, as used, is not detrimental to health but is a pecuniary fraud.

4. Other leaves, notably those of the willow, elder, and beech, are added to the tea leaves. None of these are exactly like the tea leaf, and the adulteration may be detected by close inspection even without a microscope. The border of the tea leaf is serrated nearly, but not quite, to the stalk. The primary veins run from the midrib nearly to the border, and turn in so that there is a distinct space left between their terminations and the border.

Tea dust, which consists of broken leaves and sweepings of tea storage houses, is a legitimate article of commerce, yielding an average of 1.27 per cent of theine.

COFFEE.

It is unnecessary to go into detail concerning coffee, since it resembles tea in so many of its properties. The active principle of coffee, called caffeine, is indentical in chemical composition and physiological effects with theine of tea. The per cent of this

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substance in the raw coffee berry is about one, and this is not given up so readily to water as that in tea.

There is no volatile oil corresponding to that of tea in raw coffee, but one or more such oils are generated by roasting. The physiological action is not the same, however, as that of tea. It is not so stimulating, nor does it increase the perspiration to so great an extent.

Tannin is present in a much smaller amount than in tea, and for this reason the steeping of coffee may be carried on longer than ten minutes.

The unground coffee cannot be adulterated to any extent, but the ground coffee put in packages and boxes is almost universally adulterated. Often it contains no coffee at all. A student of the writer examined all the specimens that could be obtained in the market. The first, known as Java coffee, put up by the "Centennial Coffee Company," of New York, contained, besides some coffee, chicory, pease, wheat, acorns, and corn. The second, "Gillies Gold Medal Java," contained very little coffee, being composed principally of wheat, much of it unground chicory, corn, and pease. The remaining samples were ground coffee, sold in bulk, and in every case adulterated.

CHOCOLATE.

Chocolate is prepared from the ground seeds of the fruit of the cocoa palm. Cocoa nibs consist of these seeds, which are about the size of almonds, roughly broken, while chocolate contains a substance — theobromine — very similar, but not identical with theine or caffeine. Its other constituents give it a very different position in the class of foods. The cocoa seeds contain from 45 to 49 per cent of fat, and from 14 to 18 per cent of nitrogenous matter. It will be seen from this that these seeds may be classed among the most nutritious foods. Chocolate always contains sugar, which has been mixed with the ground seeds.

Chocolate does not stimulate the nervous system to anything like the extent that tea and coffee do; but for travelers and others who cannot obtain milk, chocolate may be used instead of that, the most nutritious of liquid food.

Chocolate is often adulterated by the addition of too much sugar, or with starch.

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A MAN IN NEW HAMPSHIRE.

BY C. C. LORD, OF HOPKINTON.

I. WHAT is a man? This question is hard to answer. Man is many things. He is a machine. He is composed of many bones, muscles, nerves, etc., all designed to operate in unison in one body. Yet he is more than a body. He is endowed with certain superimposed attributes. They are sensibility, intelligence, comprehension, etc. Still every mental endowment, as well as every bodily organ, is specially identified in man's nature. There can be no true life, education, or accomplishment unless every department of man's nature is taken into account.

Structurally, man is amenable to nature's law of debt and credit. Like any machine, he wears. Every time he does, thinks, or feels anything, his constitution sustains a loss. He may not always realize this fact, but the fact still exists. Hence, being active, man is constantly in need of repairs or recuperation. But there is a more important respect in which man is a machine. He is like a clock. A clock is wound up and runs down. Man is wound up till middle life and then runs down. Man is in his full power in middle life. Before and after middle life, he is in partial power. In this he is inferior to a clock. He has no regulator to make him run evenly. Neither can he be wound up but once in a lifetime.

We have thus far spoken of man as if all men were alike. They are essentially alike so far as we have stated the case. They are unlike in every particular illustration of the general fact. No two men are just alike in their proportions of structural

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organization and power. Some men have more bone, or muscle, or nerve; others have more sensibility, or intelligence, or comprehension. The parts and attributes of manhood, therefore, express indeterminable varieties. The law of nature that affords these varieties cannot be changed. It is co-existent with creation itself. Consequently, we must contemplate the human race as an aggregate of varieties. When we order anything for human society we must do it with respect to the law of varieties. When we ask anything of a man we must do so in view of his fitness for something. The same is true when we affirm anything of a man. Hence, when we say, "a man in New Hampshire," we mean a certain kind of man. We mean one who cannot exist except in certain conditions and circumstances. We will try to define them.

II. A man is a very delicate machine. He is more delicate than the finest watch ever constructed. A fine watch is affected by a thousand and one accidents. Position, management, temperature, electricity, and many other things, affect the usefulness of a fine watch. The same is more true of a man. A watch cannot be successfully used in a place where there are many unfavorable conditions. So with a man. In New Hampshire there are certain local conditions peculiar to its latitude, longitude, and other descriptive and physical geographical aspects. No man can encounter these conditions successfully unless he has a certain personal constitution. Observe what we say. We are not speaking of bare existence in New Hampshire, nor of indifferent social life here. Like many other people of our state, we are possessed of an ideal theme of manhood. When we speak of successful life in New Hampshire, we mean the life of the standard New Hampshire man. We mean the man who can face the elements, develop manhood, and make his personal influence felt in the social circles of our state.

Let the reader in imagination take a position of observation. The place is the railroad passenger station of our state capital. The time is the middle of summer. He sees a vast number of people coming on the trains. Among them are numerous successful men. A good observer knows them at a glance. Their forms, aspects, and manners identify them unmistakably. But

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they are in great variety. The practical and the ideal, the aggressive and the submissive, the active and the sedentary, — all appear in the various forms of successful manhood. There are stout and thin men, muscular and brainy men, slow and quick men, — all leaders in their appropriate spheres. Now let us change the time of observation. The reader stands in the same place in the middle of January. There are fewer people coming now on the trains. There are fewer leading men among them. They are also more uniform in personal appearance. There is a predominance of the physically vital element among them. They incline to largeness of stature, rotundity of form, breadth and fullness of face and trunk, and general bodily solidity; but, other things equal, they have front brains of moderate size. They are strong, practical men, but they are not predominantly intellectual men. Why this great change since summer?

In the summer there were men from nearly or quite all parts of the civilized world. They were the representatives of numerous latitudes and climes. Numbers of them came to New Hampshire to stop, as it were, only a day. They came to rest from labor, breathe the air, see the landscape, or otherwise to enjoy recreation. With the advent of autumn, like birds of passage, they departed. They were not in any strict, technical sense, New Hampshire men. In the winter another and a more homogeneous class of prominent men linger here. They are the men who stay here all the year round. They are a part of our state social identity. They are the men who are as strong as our rock-ribbed hills themselves. They face the elements, encounter ruggednesses, shape enterprises, lead communities, and in an eminent sense make their personal influences felt. They are the Atlantes of our state. They carry New Hampshire on their shoulders. Other New Hampshire men have influence. These men have that kind of influence that is personally predominant, and without enlisting which no general social enterprise in New Hampshire can be accomplished.

III. Why are such men leaders in New Hampshire? They are the result of a kind of "natural selection." Roughness of surface, severity of climate, and attendant obstacles determine the form and character of predominating personal influences. A

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machine, designed to work against odds, must have strength; to have strength, it must have size; to have size, there must be a comparative absence of specially delicate functionalities. Nature makes and executes its own laws. The law of size and strength in the representative New Hampshire man does not imply other than good, practical intelligence. When so much of individual vitality is used up in developing a form and force to surmount the natural obstacles to life in New Hampshire, a comparatively small amount is left for superincumbent mentality. The true New Hampshire man is not an idealist. His mental characteristics are strongly marked, but not delicately poised. He is a reasoner, not a seer; he thinks, not dreams; he is living prose, not poetry.

The writer has seen a person of moderate vital force and delicate nature move from a low, warm latitude into New Hampshire, and in a comparatively short time lose numerous pounds in weight, though there was no attendant illness of body or mind. Whence came this loss of weight? From a loss of physical substance. Whence the loss of physical substance? From the loss of nutritive power. Whence the loss of nutritive power? From the loss of energy in maintaining life in the presence of great natural obstacles. This is an extreme case, but it furnishes an apt illustration of a general law. There is every variety of mean between two extremes. We shall see the use of this remark hereafter.

IV. All true enterprise is creative. In other words, it develops, reforms, perfects. True enterprise begins with something, and ends with something else. It makes things what they were not at first. This fact is true of material, intellectual, and moral enterprise. Material enterprise, for instance, builds a house; so intellectual enterprise establishes a theory, and moral enterprise confirms a law. Enterprise, in the end, determines advancement, leadership, lordship. He who can only repeat is of only secondary use. Such is the natural law of society, and nobody can change it. It behooves us to consider how the law of social enterprise is to be illustrated in New Hampshire.

Experimentally, enterprise begins with thought. A man first thinks of something; afterwards he does something. Thought is like the light of the sun. Its influence is universally dispersed,

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but it is caught here and there and reflected and refracted according to the nature and use of the recipient form. We have told, in a general description, the kind of manhood that shapes social affairs in our state. It follows that, individually and collectively, enterprising people in New Hampshire must aim to develop those social schemes that meet the administrative capacity of our social leaders. Socially speaking, everything else, however genuine it may be, must exist only as an ideal element and not as a fact of actual realization. In other words, we in New Hampshire can do nothing but that which our soil and climate in their circumstantial details will let us do. However, let us not mistake. The writer does not purpose to assume the attitude of a prophet. We are not specially designing to forecast future ultimate results, but to consider the law of local enterprise.

All our individual and collective efforts in New Hampshire should illustrate economy. We should ascertain and utilize the true value of everything. Waste is specially ruinous in our state. We must labor to save our bodies, brains, hands, and materials. In a land where simple existence reduces the physical substance of the most delicate human organism, no one can afford to trifle with his resources. In New Hampshire, a man should consider economy when he eats or drinks, lies down or rises up, goes out or comes in, works or rests. In this we tread upon the domain of physical and material details, but we cannot stop to enter it. However, the enforcement of the economical idea suggests a limitation of operation. We should not take up too much ground. One thing well done is better than many things badly done. This is true everywhere, but especially in New Hampshire. The application of the thought extends to every department of use. It is physical, mental, and moral truth. An honest New Hampshire farmer, who recently advised an organization of the Patrons of Husbandry to discuss all profitable social subjects, was in practical error. A social organization in New Hampshire should have one predominant purpose, thought, and action, and no more. Dividing its object, it wastes its resources and ruins its prospects. The same is true of an individual. This reflection leads us to further incidental remark.

V. Each sphere of operation in New Hampshire is necessarily

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limited. Local accomplishments must therefore be special. Life in our state will not admit of a prevalence of glittering generalties. Energy, enterprise, and success must be departmental in character. There can be few truly great men in New Hampshire. There are and will be in our state men of strong purposes and relatively impregnable judgment and efficiency in their particular spheres. The truly great man, however, has a logical conception, as it were, of all spheres and objects, and can turn his genius successfully to multifarious ends. Men of great capacities may be born in New Hampshire, but they will eventually migrate or become stunted by the stress of circumstances. Our possibilities of accomplishment being special, our methods must be likewise. We have already affirmed this point. We now proceed to a more distinctive illustration of it. In New Hampshire, when social plans are laid, the work should be done with reference to natural and unavoidable contingencies. In our state labor must be predominantly manual, in distinction from mental; intellect must be practical, in distinction from ideal; morals must be positive, in distinction from negative. Where the soil is hard and the climate chill, he who successfully encounters the natural obstacles to life develops a characteristic aggressiveness of purpose and thought that will not readily brook the restraints of refined social policies. The ecclesiastical dignitary who once said that he found "will and won't Christians everywhere, and especially in New Hampshire," was not altogether a subject of prejudice. The predominance of the positive conception in local society is easily demonstrated. The writer has listened in New Hampshire to public discourses, delivered by men of eminently comprehensive knowledge, thought, and instructiveness, when their words fell almost fruitlessly upon the ears of their audiences. There was not enough of special application and emphatic assertion in their utterances. On the other hand, a man of few ideas, but with the capability of dealing out words in sledge hammer blows, will often carry a New Hampshire audience by storm. In the progress of society, from generation to generation, a condition of practical necessity assumes the form of an inherited predisposition. In the minds of the children of our state there is witnessed an unmistakable tendency to the assertion of an instinct of posi-

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tiveness. This assertion obtains in the schoolroom. It occasions the frequent predominance of mathematics in the school curriculum. In general, our boys and girls will learn arithmetic, algegra, etc., to the expense of other things. A school teacher, also, is often ignorantly assumed to be full-fledged if efficient in mathematics, whether he knows anything else or not. Apparently, a teacher who is deficient in many other things can sustain a reputation in many localities if he is reliable in mathematics. Whence this subtle ascendency of figures? From the necessity of calculation. Whence the necessity of calculation? From the struggle for existence. To the child, to the teacher, to the parent, the inevitable digit is the symbol of a living in the face of portentous obstacles, before which there is an unavoidable endeavor to reduce everything to a mathematical certainty. In the sphere of the calculation table are hope and life, but without are despair and death.

VI. Our subject is inexhaustible, but we must hasten to a close. One or two remaining reflections will be condensed and general. We may profitably add a few observations upon citizenship. We have seen that certain circumscribed possibilities are open to the people of New Hampshire. We have defined certain dominant features of those possibilities; consequently we have nothing essentially new to express. Still we may add something that will increase the practical emphasis of our general theory. The predominantly successful manhood attainable in New Hampshire being of a positive, strongly individualized cast, popular society in every department is marked by vigorous outlines of public policy. This fact we have already illustrated. In citizenship, our inevitable popular characteristic develops into a jealousy of personal identities and local privileges. In sentiment, and in a large measure in practice, the political conception of our New Hampshire citizens is and will be democratic. We separate the term democratic from its commonly entertained significance. We need not ask if a large political party in our state is called democratic, republican, or something else. No large party in New Hampshire will ignore the importance of individual ambition, effort and accomplishment in political counsels; nor will it disregard the claims of local communities in the departments of

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state. To live, grow, and thrive in New Hampshire requires too much identification of individual energy to make it possible for any administration to overlook its relative significance and claim. Names may change, men may die, organizations may dissolve, but the masses of the people contending with a rough climate and a hard soil, the leaders of every considerable community will be as firm in their individualized and localized conceptions of privilege as our eternal mountains. All the conceptions, sentiments, and ideals in contravention of the purest democracy that creep into the minds of our New Hampshire people are like delicacies on the substantially furnished table of a state citizen; they are only to be tasted, not appropriated as main reliances. Political life in New Hampshire may occasionally muse in a dream, but it must mainly struggle with positive realities. We may have many a Cassius, and occasionally a Brutus, but a Cæsar is a political exotic that can flourish never.

A great deal is now being said about the possibilities of life and enterprise in New Hampshire. Our people are advised to remain, work, and prosper. We find no fault in the premises. We have endeavored to point out certain unavoidable contingencies in local human existence. We have tried to show what people must keep in mind while they are trying to live in New Hampshire, conceiving our state as their promised land. Every considerable community is largely composed of laborious people, exposed more or less to conditions presented by nature itself. Whoever lives long in any community, all the time engaged in the struggle for existence, unavoidably becomes an integral part and parcel of the local, social compact itself. It is of no use for a man to reside in New Hampshire, thinking he can live and be just the same as if our soil were an easy instead of a hard one, and our average annual temperature 60 to 80 degrees above zero instead of 40 to 50. We have sufficiently detailed our reasons for this conclusion.

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THE FAMILY GARDEN AND ITS PRODUCTS.

BY A. J. FOGG, ESQ., OF NORTHWOOD.

It is a common saying in country, town, and village, "My garden furnishes half the living for my family through the summer and fall."

While this may be an exaggerated expression, nevertheless it cannot be denied but the products of a well cultivated garden furnish a large portion of the most palatable and healthful food that comes to the table of the rich or poor man through the warmer months of the year. A dinner-table in the summer or fall, devoid of the products of the family garden, is about as enjoyable as a religious service without singing. In fact, through the year, a well supplied table is represented by the products of the garden to a greater or less extent. The cabbage, beet, turnip, squash, parsnip, onion, etc., belong to the dainties of the table of the epicurean through the winter and spring as well as in the warmer months.

There are in the United States not far from five million farms and twelve million families. Twenty-five per cent of these families live in the cities and large villages, leaving seventy-five per cent or nine million in the country; and it is safe to state that there are nine million family gardens (not to say anything of "market gardens") in this country.

The managers of our national census at the various decades have neglected to prepare any tables to furnish an approximate value of our family garden products, but only the amount sold as market garden products. As rendered by the census of 1870,

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the amount of garden vegetables sold the year previous was $20,700,000, and in 1880 about the same value, owing to the depreciation of values in currency. The value of market garden products sold at the present time is not far from $35,000,000, or nearly half the value of the orchard production of the country, which includes apples, pears, peaches, oranges, etc. The value of the products of the family garden has never been considered by our statistical officials, but there is no doubt if the true figures could be obtained, it would aggregate the large sum of $150,000,000 annually. It is also a noted fact that the agricultural department at Washington has not given that attention to the garden which it deserves. A few garden seeds are annually distributed, but that is about all, except now and then a paper on some kind of insects affecting garden vegetables, accompanied by an indefinite remedy.

There is no use in disguising the truth, for, as a rule, the family garden of the farmer does not receive that attention which its importance merits in aiding the support of a family if rightly managed. The farmer is too apt to think that two or three acres of corn must be attended to, if many of the wants in the garden are neglected. He forgets that a half acre of garden ground well cultivated will yield in all its various products more value toward the support of a family, over and above expenses, than any two acres of corn or potatoes ever grown. The garden is one of the principal sources from which springs a large portion of the luxuries of our tables, yet it is one of the most neglected plots of ground, considering its value, that the farmer possesses. Rainy days and odd hours are usually all the time the farmer spares to cultivate his garden, and it is a lamentable fact that in many gardens the rankest crop is the grass and weeds which are suffered to grow through neglect, and thereby check the plants and exhaust the fertility of the ground. But such neglect by many farmers must be expected as long as public men neglect to investigate the importance and value of the garden and give statistical facts.

While we acknowledge the supremacy of gardens, as now cultivated, over other lands the farmer tills, yet their value could be doubled if properly attended to or as is the well managed market garden. We know a market garden of sixty-five acres, with com-

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mon seasons as to wet or dry, that yields an annual value in the various kinds of garden products of $10,000. Thirty years ago this same land, then under the ordinary farm cultivation, did not yield an annual value of $500, "all told." It is not to be expected, or even desired, that all farm lands should be cultivated under the market or family garden process, but as far as the family garden is concerned, its product is not overdone, and double the amount could be raised and used to advantage in families that pretend to cultivate gardens for their own use.

But we commenced this article to speak more particularly of

THE CABBAGE, ITS CULTURE, PROTECTION, AND USES.

This is one of the most important and useful vegetables raised. A dinner-pot in almost any family in the fall, winter, or spring, with a supply of corned beef, pork, bacon, and potatoes, is considered rather barren if the cabbage is not boiling beneath its lid. Owing to our varied climate in this country, north and south, and quick mode of transportation, together with keeping the cabbage five or six months after it is harvested, it is usually found in the markets of all our northern cities and large villages in every month in the year.

The people living in New England, in proportion to the population, do not raise or consume as many cabbages as they do in many other sections of our country where there is a large element of foreign population. As a general rule, the manner of cooking cabbage in the eastern states, and especially in the rural districts, is to boil it with some kind of salt meat; but in many sections of New York and states west, where the German population is quite a per cent of the whole, the cabbage is served in various styles,—such as boiling with salt and smoked meat, chopping fine and frying, seasoned with butter, pepper, and salt to suit the taste. It is used as pickled "slaw" in soups, and largely in what is called by the Dutch of Holland "sour-crout." We well know that this Dutch food is ridiculed by nearly all New Englanders who have tasted it (and by those who have not), owing to its peculiar smell; but let any Yankee go west, and take up his abode where there is quite a sprinkling of Germans, and he will soon learn to relish "sour-crout" and will frequently "hold up his plate for more."

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It may not be amiss to state to New Hampshire people, and especially the housewives, how "sour-crout" is made. Late in October take solid cabbage-heads and chop them fine with a chopping-knife, sprinkle some coarse salt in the bottom of a barrel or any other tight vessel, and then place in a layer of the cabbage and press or pound it down solid, and then more salt, and so on until the desired quantity is obtained; then put the barrel in a cool place, and the salt and cabbage will soon create a brine which in a short time will work or ferment, and cause an acid taste to the cabbage, and it will become quite tender. It will take some four weeks for the compound to go through this process, but if that is too long to wait, the vessel can be placed near a stove and it may be ready for use in about ten or fifteen days. But if the barrel is placed in a dry cellar, the contents will not emit such an odor, and the "crout" will keep good till late in the spring.

The "crout" is served by frying in butter, and may be used with vinegar when eaten, or it is very good cold as a relish. When living in Washington we boarded in a New England family, and through the spring it was on the table nearly every morning, and we noticed that the eastern boarders did not "pass it by." It is generally used by many families living on the Hudson below the mouth of the Mohawk, where there is a large foreign population. On the Hudson flats between Cohoes and Albany, the average crop of cabbage is estimated at over 1,000,000 heads annually, and upon the Mohawk as many more, besides the market gardens in the vicinity of Albany and Troy back from the river flats. In the immediate vicinity of Washington, D. C., the market gardens raise from five to twenty thousand heads annually, and in the northern section of Prince George's county, Md., market farmers plant from 25,000 to 160,000 heads, and much of it is used in "sour-crout."

In Albany or Troy it is not considered an extreme quantity for a person to purchase one hundred heads of cabbage for family use through the winter, and this four dollars' worth of cabbage, they say, will go further toward supporting a family than twenty dollars expended in any other way. In the time of the late war, in 1864, the Soldier's Aid Society at Cincinnati thought they would

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send their "boys at the front" some dainties for the holidays, and among the viands selected were two hundred barrels of "sour-crout." These facts furnish sufficient or conclusive evidence that what is termed a Dutch food is considered a luxury by many people in this country. Let our New Hampshire housewives put up a jar of "sour-crout," and while they may not become Dutch women in every sense, still they may become lovers of one of the Dutch modes of cooking cabbage. In the kingdom of Wurtemberg, Germany, with an area not as large as Massachusetts, and a population of less than 2,000,000, our consul reports the average annual yield of cabbage at over 50,000,000 heads.

Owing to the thick leaves of the cabbage, it retains its succulent nature for a longer period after harvesting than almost any vegetable whose nutritious qualities grow above the ground. If properly cared for, it will retain its green, succulent state for five or six months. Cattle are fond of cabbage, and it is not expensive; besides it is beneficial to feed a few heads to them every week through the winter for a change. The same can be said of fowls. They are as herbiverous as the cow or ox, only they require their vegetables green and juicy. Nothing is more healthful and beneficial to hens, turkeys, geese, etc., than cabbage fed two or three times a week through the winter and spring. It is no more expensive than corn or potatoes if farmers would think so and act accordingly.

The best kind of soil to grow cabbage is moist, sandy ground. But almost any soil (if not dry and sandy) well manured will grow a fair crop if properly attended to. With the exception of clear hog manure, almost any kind of manure well rotted and mixed with the soil will answer for cabbage. But it is better to spread on the coarser manures in the fall and plow it under and again plow the ground in the spring and apply the finer fertilizers in or around the hills of cabbage, such as phosphates, guano, night and hen manure compost in the cabbage hills, and ashes, lime, etc., on and around the cabbage; refuse salt is also good to spread on the ground. The more ammonia in the ground the better for cabbage, — to prevent club-foot and to promote their general growth.

Cabbage for fall or winter use should have its seed sown about

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the first or middle of June, and for early use in New Hampshire about the first of May. Some prepare the ground and sow their seed where they intend the cabbage to stand and grow, while many sow the seeds in one part of their cabbage plot and when large enough take up and transplant in rows. We prefer the latter course as they can be set out more even and the ground better prepared for a successful growth. Where the ground is rich, the rows should be about three feet apart, and the cabbages two or two and a half feet apart in the rows. Before the plant is set, the ground should be well pulverized and about one and a half tablespoonfuls of phosphate put in each hill; but care should be taken that none of the roots of the cabbage directly touch any of the phosphate, as it is sure to eat the fibers of the roots and retard the growth of the plant and perhaps destroy it. Where there are not more than two or three hundred plants to be set, it is far better to put the phosphate in the hill some two or three weeks before the plant is set out. By this process the strength is neutralized with the soil and is far less liable to injure the plant. But where there is a large area set with cabbage and the ground is furrowed out, this cannot be expeditiously done, and the phosphate must be put in when the plant is set.

An acre of ground will set from 6,000 to 8,000 plants, and we have heard of 10,000 plants on an acre, while others set out as low as 5,000 plants. Cabbage plants should be set low enough in the ground so that after they are cultivated and sufficiently hoed, the surface of the ground will be level or, if anything, concaving towards the stem of the cabbage, so when it rains, the water will settle around the roots instead of running into the center of the rows, as is too often seen. This keeping the surface of the ground level is applicable to nearly all garden products, field corn, etc. We would say here, it does not require any more time to do such things right than to do them wrong, and often not as much. The ground around cabbages should be stirred often, and a spoonful of ashes frequently strewn around the plant is beneficial.

When cabbage plants break the ground from the seed, they become the victim of attacks from animated nature, comprising quite a portion of the insect tribe or family, until they are

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gathered some four months later. First, they are attacked by the voracious fly, flea, or beetle. A frequent sprinkling of wood ashes and air-slaked lime, when the young leaves are wet with dew or rain, is generally an efficacious remedy in protecting the young plants from being destroyed by these pests.

The next enemy the cabbage has to contend with, against annihilation, is the cut-worm, about the time the young cabbage is transplanted, or left alone in the hill to grow and "head." There are several species of these cut-worms, as they are called by entomologists. They are called the dark-sided cut-worm, the variegated, speckled, glassy, greasy, w-marked, shagreened, and granulated cut-worm. To the unobserving farmer, relative to cut-worms, all these various species look nearly alike, but many of these kinds are seldom seen in the northern states, but are common in the south and southwestern states. The most common kinds in New England are the w-marked and greasy cut-worm.

The cut-worm, in its coming into existence, is of the lepidopterous order. After existing in a larva or worm state, feeding on vegetation, it crawls to some dark retreat near or in the ground, and winds itself in its web into a pupa state, or more like a cocoon, and in a few weeks the apparently curious worm comes out into a beautiful butterfly or moth, and after a few weeks longer this moth lays its eggs, and in a short time the larva is hatched out and soon becomes a full-grown worm. In the warmer climates, this metamorphosis of the cut-worm is frequently three times a year, but in the northern states it is doubtful if it occurs more than once.

The moth of the cut-worm is nocturnal in its habits, and usually flies only after dark, or just at dusk of evening, and directly does no injury to plants in its transitory life; but of its progeny, the cut-worm, not so favorable a record can be given. In the northern states, the larva is hatched out late in the summer and fall and feeds on such vegetation as it can obtain, and hibernates till the frost leaves the ground in the spring, when it comes out ready to attack any tender plant that may come in its way. While it may thrive on some kinds of weeds and spontaneous vegetation, the farmer only particularly notices its visits for food

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when he sees the young stalk of the cabbage, bean, tomato, corn, pea, etc., eaten off near the top of the ground, and finds their executioner apparently safely burrowed in the ground near the trunk of its beheaded victims. There is no resurrection or resuscitation of his wormship's victim any more than there would be to the decapitated chicken, and the only consolation the farmer or gardener can get out of the source of his trouble is to bruise its head under the heel of his boot.

The full-grown cut-worm in the spring and early summer months is about one inch long, and of a dark brown color, with almost indistinct stripes of a lighter or darker hue running along its sides or back. It burrows in the ground and is nocturnal in its manner of getting food, coming out at night and crawling along on the surface of the ground till it comes to the bean, cabbage, etc., and eats it off near the ground. If satisfied with its meal it will again burrow near the roots of the plant it has cut off, where the farmer finds it and wreaks his vengance on it in the morning. But if the appetite of the worm is not satisfied on decapitating the first plant, it goes to the next; and one worm has been known to eat off three cabbage plants in one night. The moth has dark brown wings and is not as handsome as some of the butterflies seen flying in the daytime.

But the work of the cut-worm on the cabbage plant is more serious than on many other plants, like the cucumber, beet, bean, etc., for the reason there is more than one plant in a hill, and if they are thinned out by the cut-worm it may effect no injury. But the cabbage is different. When the plant is gone, another one must be put in its place, or the ground left vacant. It requires time and patience to reset these cabbage plants; besides, it makes the growth uneven, but it is the only alternative after the plant is cut off. Some years, twenty and even fifty per cent of the cabbage plants are eaten off by the cut-worm. The inquiries in regard to cabbage worms, and the best remedies to evade their annual attacks, of late years have been so numerous that the heads of the agricultural department at Washington have made a thorough investigation in various sections of the country, how to treat these pests, but as yet have arrived to no effectual or satisfactory remedy to fully prevent their periodical ravages.

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It can be said here that not one tenth of the cabbage worms hatched from the eggs of the moths ever return to a pupa state, but are dstroyed by parasites, which are natural enemies of the cabbage worm. They spring from a fly that lays its eggs upon the larva by a puncture through its skin or scale, and frequently the worm is not destroyed till in a chrysalis state and never comes out a miller or moth. The agricultural reports of 1883 and 1884 have each some forty pages devoted to cabbage worms, as to their habits and how to prevent their destroying the young plants and the growing cabbage.

As a protection to young plants from the cut-worm, the report of 1884 recommended several remedies, but nothing that is fully satisfactory. One correspondent suggests, when the young plant is set out, wrapping the stem in a walnut leaf or brown paper so that the worm will not be able to reach the stem. But the report says, "A good deal of time and care are necessary to make a perfect wrapping of the stem, and this constitutes, so far as we are aware, the only objection to the use of this preventive."

Another preventive "consists in trapping the worms in deep holes near the base of the plants. For this purpose, a long, smooth, sharpened stake, an inch or two in diameter, is used, and almost as fast as a person can walk through the field, it can be thrust once or twice deep into the ground near each plant, leaving a smooth, round hole, out of which, the cut-worms having once fallen in cannot crawl, and the chances are that in their nocturnal prowlings they are pretty sure to fall into this well." We are led to believe the chances are they will not fall into these pits, but will crawl between them and destroy the plant. We have seen plants eaten off within an inch of one of these holes. This is not a new remedy, but was advocated over fifty years ago, yet has been but very little practiced.

Dr. Ormler, of Wilmington Island, near Savannah, Ga., says: "My method of dealing with cut-worms of late years has been to remove them from the field before the crop to be jeopardized is up or the plants put out. By placing cabbage leaves and bundles of grass along the rows of watermelon hills four years ago, I caught, by hunting them daily, 1,538 worms on about one fourth of an acre, before the seed was up, and lost but a single melon

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plant." Again, the doctor says: "After the land is prepared for cabbages or any other crop needing protection, I place cabbage or turnip leaves in rows fifteen or twenty feet apart, all over the field, and about the same distance apart in the rows. The leaves are first dipped in a well-stirred mixture of a tablespoonful of Paris green to the bucket of water, or they may be first moistened, then dusted with a mixture of one part of Paris green to twenty of flour and placed carefully with the dusted surface next to the ground. Two such applications, particularly in cloudy weather, at intervals of three or four days will suffice to allow the cut-worms to make away with themselves, which they generally do with perfect success."

Professor Riley, the national entomologist, recommends the doctor's remedy, only he chiefly uses clover sprinkled with Paris green water, laid at intervals between the rows. But if this is efficacious, it would not be a satisfactory preventive, for a large portion of the farmers would not have poison scattered around so promiscuously where fowl or cattle are liable to eat it and especially where there are young children in the household.

But the most effectual remedy for the protection of young cabbage plants against these brown cut-worms that do their work by night is a new invention, for which an application is being made for a patent right, and is called a "Cabbage Plant Protector." This protector is a cylinder three inches, more or less, in diameter, and about two inches wide, and is made of any kind of sheet metal, but tin is the best. The sheet is cut about ten inches long and of the proper width, with a flange on each end, like that on a stove pipe, and then locked together, which makes a perfect cylinder. When the plant is set out, the protector is locked around it and sunk about half an inch into the ground, which makes a perfect fortress around the cabbage that his wormship can neither eat through, crawl over, nor dig under.

These protectors can be made large enough for cucumber hills or other choice plants, and there is no doubt but it is a sure preventive against these cut-worms eating off young plants. It is also claimed as being beneficial in growing plants, by the metal drawing the heat and moisture around the plant. When the cabbage or other plants need hoeing (which is often) the

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protector can be unlocked and taken away without injury to the plant and be replaced again in a moment's time; and in a dry time, when irrigation is required, the cylinder will hold the water around the plant, which will reach the roots, instead of running off on the surface of the ground. The expense of these protectors will be but a trifle, say not over 25 cents a dozen, while they will last for many years, if properly taken care of when not in use.

After the young cabbage plant has escaped annihilation in a single night by ground cut-worms, and begins to assume a respectable size, new dangers begin to threaten its further development. The last of July, especially if it is a dry season, butterflies, from white wings down to brown, are seen fluttering over the cabbage yards, which is sure to augur no good to this useful vegetable. The yellow wing moths, with one or two dark round spots upon each wing, are the most common to be seen; but other species are there and their progeny sooner or later will be sure to develop itself to the detriment of the cabbage.

These butterflies are of the lepidopterous family and spring from the pupa of the worm. The moth lays its eggs on the under side of the cabbage leaf, and usually but two or three in one place, which makes it quite difficult to find them. If it is warm and dry, these eggs will hatch out in ten or twelve days and produce a green worm or larva that in ten or twelve days longer will be over an inch long, and usually feeds on the top of the leaf near the head. They are great eaters, but their digestive organs are very limited, as their excrements are nearly all cabbage and generally detect the work of the worm, which, by careful search, can be found and destroyed.

While nearly all of these green worms look nearly alike to the not over-scrutinizing farmer or gardener, yet there is a wide difference in their mode of eating the cabbage. The most dangerous of these insects to the cabbage springs from what is called the rape butterfly, and is a native of Europe. It was first known in America in 1857, and it was supposed to have been imported to Quebec with a lot of vegetables in 1856, and from this point they have been scattered over nearly every section of the United States. We here quote the description of this butterfly as given by Mr. Riley, the national entomologist: —

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"The butterfly has the body black above, with the wings white. The front wings are black at the tip, and have, in the male, one black spot between the middle and the posterior edge, but the female has two black spots, sometimes three. The hind wings have a black spot on the front margin above, and all the wings are marked underneath very much as those of the female above, except there are no black spots on the hind wings. The hinds wings below are yellowish, sometimes becoming even green. The species vary much, and there is a specimen in our collection in which the spots are so nearly obsolete above, that if it were not for the characteristic under surface, it could scarcely be distinguished from the potherb butterfly. There is also an infrequent variety which has the ground-color canary-yellow, instead of white, and which occurs mostly in the male sex, but occasionally in the female. The butterflies are slow and lumbering fliers, but are among the most assiduous insects, continuing on the wing from early morning till late in the afternoon. The eggs are deposited singly or in clusters of not more than two or three on the under side of the leaves. The eggs are laid at all times throughout the growing season of the year, or from May to October, in temperate zone."

It is very evident that the wings of this species of butterflies are more frequently yellow and adorned with black spots than formerly, especially in the more northern states. And further, the warmer and drier it is, the more prolific are the butterflies and the worms, and consequently the more disastrous to the cabbage. After the worm is changed into a chrysalis state, if the weather is warm and dry it becomes a butterfly in about two weeks, but if it is rather cold and wet, the chrysalis remains in the same state through the winter and the moth does not come out until warm weather. It is the same with the eggs of the moth; if it does not continue warm in the fall months they will not hatch, and if frozen will never mature any more than the egg of a fowl. During the past season the warm and protracted dry weather was suitably adapted to the growing of butterflies and the breeding and ravages of worms on vegetables, especially the cabbage, and there is a general complaint of the cabbage worm on the later crops.

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One writer, in speaking of the rape worm, says: "It is not content with riddling the outside leaves, but prefers to secrete itself in the heart, so that every cabbage has to be torn apart and examined before cooked. It is also necessary to keep a continual lookout, even after it is dished up, lest one gets such an admixture of animal and vegetable food as is not deemed palatable by the most of men." What has here been said of the origin and character of the rape cabbage worm is applicable, to a more or less extent, to all the greenish worms the farmer or gardener finds on his cabbage. While not like the brown cut-worm that crawls on the ground by night and destroys the young cabbage at a single stroke by decapitation, yet the green worm at a later date can work a great injury to the cabbage if not vigilantly watched. There is a small worm of a greenish color that is rather gregarious in its habits, and feeds on the expanded outer leaves of the cabbage and on the under side, but never touches the inner heads. These worms can easily be detected in their work by the edge of the leaf appearing dead and dry. Turn this leaf up, and perhaps fifty of these little worms about a quarter of an inch long will be discovered vigorously at work. In this case, tear off the part of the leaf containing the worms and stamp them under your feet.

Another pest to the cabbage is what is called the aphis fly, which makes its appearance in July and frequently remains till late in the fall. They come in large numbers, and produce the cabbage-plant louse, which is often found on the under side of loose cabbage leaves and upon the outer side of leaves near the head. If suffered to remain undisturbed near the head, the leaves become putrid with this mass of lice which will soon render the whole cabbage unfit for use. If the infected leaf is in its incipient stages, tear it off and destroy it. The cabbage-plant fly is another species. They deposit their eggs on the stem of the plant near the ground and produce the maggots that prey upon the roots of turnip as well as cabbage. It is claimed by many, and there is but little doubt that the work of these maggots is one of the causes that produce the club-root on cabbage. There are various remedies advanced to protect the plants from these maggots, such as dipping the roots, as the young cabbage is

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transplanted, in oil or lye of ashes, sifting powdered tobacco on the leaves, etc.

But the best and only practicable remedy is to properly prepare the ground prior to transplanting with a fair quantity of ashes, a sprinkling of salt, and a tablespoonful of phosphate in each hill or where the plant is to be set; and after it is transplanted put the plant protector around the young cabbage, and then sprinkle a few ashes within the cylinder, and no fly will venture to lay its eggs within the circle, neither would they hatch nor the maggots live in the ground prepared as herein stated. Besides it being a sure preventive against maggots, it is the best mode to promote a successful growth of cabbage, and consequently in applying this remedy it creates no extra expense.

The remedies advanced to prevent the ravages of the green worm on cabbages partly grown are numerous, and in our judgment and experience but very few have any practicable effect or benefit in their application. We herewith briefly give a few of the many remedies as laid down in the various agricultural reports published at Washington. One says: "Hot water will kill every worm visible upon the cabbages. The water may be boiling hot when put in the watering can, but it will not be too hot when it reaches the cabbage leaves. The thick, fleshy nature of the leaves enables them to withstand considerable heat with very little injury." There is no doubt but hot water will kill the worm, and also place the cabbage in a precarious condition after it has been thoroughly saturated with boiling water, as not a quarter of the worms are visible but are down beside the heads near the roots of the leaves, and will require much water to reach them. This remedy, to be efficacious, will work like applying oil to the root of a cabbage plant to destroy maggots. In both cases, nine times out of ten, the remedy would destroy the cabbage as well as the worms and maggots.

The Persian insect powder is advocated as a remedy, at the rate of two hundred grains of powder with two gallons of water, and the mixture sprinkled on the leaves of the cabbage. This may do where the compound reaches the worm, but, as we said before, not half the worms will be touched and they will continue to "thrive and grow fat" under this treatment. Kerosene emulsion,

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made by heating a solution of soap and adding it boiling hot to the kerosene, is strongly advocated. Churn the mixture by means of a force pump for five or ten minutes, or until it forms a cream, which will thicken on cooling. After going through this process successfully, take one part of the emlusion to nine parts of water and sprinkle or spray it over the leaves of the cabbage. While this compound may be effectual where it reaches the worm, the trouble is that very few of the worms will be touched, owing to the broad leaves of the cabbage and the insect being between them. Then again, there is great trouble in making a perfect emulsion, and if this is not accomplished, the particles of kerosene will injure or spoil the cabbage for culinary use. In fact, at first this emulsion was never intended for cabbage but for destroying insects on fruit trees and especially in the orange groves in Florida.

Dry application of lime, salt, pepper, or bran, road dust, or any other powder not deleterious in human food, is recommended against young worms. We are of the opinion that dry wood ashes moderately sprinkled on the cabbage is the most effectual remedy. As many of the worms are near the roots of the leaf and no dust can reach them to deter them from taking their daily meal, the dew or rain will create a lye from the ashes which will run down on the stem of the leaf to the roots and molest the worms. While the cabbage will stand quite a strong lye without injury, the worm will leave or die from the effects of the lye. But all these remedies depend largely on how plenty the worms are. If there are but a few worms, the application of salt, pepper, etc., may show considerable improvement against worms, but if the worms are numerous these remedies have but very little effect.

There is no doubt but the remedy should be applied at the origin of the trouble to be effectual. If the butterfly that lays the eggs which produce the worm could be destroyed or prevented from depositing its eggs on the cabbage leaf, then the cabbage would be safe from the ravages of these worms. Some advocate that poison sprinkled on the leaf will kill the moth or the eggs; but this is dangerous and many of the eggs would not be touched by the poison. In dry weather the butterfly is a thirsty

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insect, and will draw moisture where it can be found. Take fly paper or any thick paper saturated with a poisonous liquid and lay it on cabbage leaves near the ground, and it will be sure to be found by the thirsty butterfly and destroy many of them; but still many will escape and lay their eggs, and worms will grow and eat cabbage, but it will lessen their number. Other simple remedies heretofore spoken of may save the cabbages from much injury.

Another remedy, which incidentally comes under our observation this season, we have faith as being the most efficacious of any yet advanced. A farmer near me, to save his cabbage from being destroyed by his hens, set some hundred plants in his cornfield. There are six rows of corn before the cabbages are reached and two rows are left vacant for the cabbages. While all cabbage yards in this vicinity have been much troubled by worms, these cabbages have hardly been molested. The butterfly flies low as a rule, and the thick corn has prevented it from reaching this farmer's cabbage to any extent. One warm afternoon while hundreds of butterflies were fluttering over and through my cabbage patch, I visited these cabbages in the corn and not a butterfly could be seen. If this is a preventive to debar butterflies from laying their eggs on cabbages, which produces these destructive green worms, it will be but little trouble for the farmer to prepare his narrow cabbage patch in his cornfield and with the aid of the cabbage plant protector against the brown cut-worm there will be no trouble to grow cabbages. Also the gardener can plant his sweet corn around his cabbage plot the same way. This may not be an effectual remedy, but it certainly has an apparently tangible argument in its favor. At any rate, it will cost but a very little time and expense to try it.

We have endeavored in a brief way to show the importance and benefit of a well cultivated garden, and how the cabbage should be treated from its incipient stages down to the culinary department; also the worm, which seeks its destruction from the young plant to the time it is harvested. There never will be an effectual remedy against the ravages of insects on the husbandman's crops, but in a measure they can be relieved. The farmer's work is based on uncertainty from the commencement until his

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crops are gathered. It may be too dry or too late, or the insects may ravage, but when year after year rolls round, the constant and vigilant labor of the farmer is crowned with success. If the gentle hints on the various subjects brought up in this article may prove of some benefit to a few of the many, then our efforts have not been wholly in vain.

[NOTE. — It is proposed to publish a series of articles, similar to the above, in relation to other garden products. — *Sec.*]

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SOME OF THE ATMOSPHERIC PHENOMENA.

BY S. D. LORD, OF MANCHESTER.

STORMS are generated in the atmosphere out of its constituents. They receive their support from it. Their energies originate from and are exhausted in the atmosphere. Storms are the result of forces, as well as of materials, always present in the heavens.

They are not lawless, but have method and are as subservient to law as the summer cumulus that floats above us, and yield to gravitation as readily as the drop of rain that falls from their angry clouds. We need not be surprised then when the gentle zephyrs are transformed to the wild hurricane and the air is thick with clouds, for we know the summer morning conceals within its loveliness all the elements of clouds, cyclones, and the fire of electricity. There is but a change of conditions when the heavens are darkened with clouds and the tornado rolls in their midst.

If we look for the forces developed in the mechanics of storms, we find the same agents at work there — heat and gravity — as are found everywhere in nature, and the materials they work upon are the atmosphere and the moisture it contains.

To better study our subject, we will ascend to the storm clouds. We see them to be mists, lighter than the air, therefore floating in it. Particles of these mists united together become heavier than the atmosphere and drop in rain to the earth. These, with the glare of lightning and the winds, moving the clouds apparently around a common center, — hence called cyclonic, — are all we find.

Our analysis is truly simple, and we comprehend it. But the cloud mass becomes denser, larger. The wind increases in force

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because the atmosphere yields its moisture to the clouds, and the vacant air seeks its equilibrium with tremendous force. Now we understand this — the hurricane. Let us here apply our early studies. Water by heat is transformed to vapor, and the moisture by a change to a sufficiently low temperature is reduced to water again.

In these changes energies are collected or dispersed. Water is 770 times heavier than air, and a cubic foot of water converted to vapor would fill a space of some 1,700 cubic feet, that is, 1,699 cubic feet more than the original water occupied. Now, if this 1,700 cubic feet of vapor were suddenly reduced to water, there would be a vacuum of the 1,699 feet. Here is the vacuum for the winds to fill; they are demanded, and are more or less in force according as the vacuum is more or less complete. Here is the origin of storm winds. It is now our duty to speak more particularly of winds, as they form a very conspicuous part in all storms.

Wind is air in motion and elementary writers say there are *three forces* acting upon the atmosphere to give it motion, and Prof. Ferrel, formerly in the Signal Service department, names a fourth. These winds are developed as follows: 1. By difference in the weight or specific gravity of the atmosphere in different localities at the same time; 2. In the tendency of the atmosphere like liquids to move to lower levels; 3. By the daily revolution of the earth; 4. In the language of Prof. Ferrel, it "arises from a combination of a rotative east or west motion of the atmosphere with the rotatory motion of the earth."

There is also an annual or orbital motion of the earth which I desire to consider in this connection. It may be included in the *third* force named before, but it presents to me a force much more important in relation to winds than the simple revolution of the earth on its axis. To explain, Mr. Ferrel and others credit this *third* wind to the simple daily revolution of the earth on its axis, which at the equator is something over one thousand miles per hour, diminishing in velocity every degree north and south, till at the poles it becomes zero, while the orbital motion is at the rate of 65,000 miles and more per hour, and is not considered by them. They would estimate only the revolving force of the ball

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shot from the rifled cannon, while the momentum of the ball in its flight is not made a factor. It is evident, I think, the annual motion of the earth is the principle cause of this wind influence, with a slight increment of force by the daily revolution.

The air is considered an elastic body — forty-five miles or more in depth surrounding the globe — which moves upward of 65,000 miles per hour in its orbit and it must, it would seem, present a difference in depth in its *east* front and *west* rear as the earth plunges into space, and this would cause necessarily a difference in weight of the atmosphere on the earth as it revolves. There is such a difference daily as determined by the barometer, perhaps also explainable otherwise. There is a mean maximum and also a mean minimum pressure. This then may be a *fifth* influence or force acting to produce wind.

This explains the trade winds equally with the daily revolution which acts with it.

I give also (to digress a moment) some credit to this orbital motion of the earth in producing the ocean currents. The earth moving with great velocity to the east, the waters of the ocean mobile in every way in seeking an equilibrium would meet the advancing eastern shores greatly swollen, and a current as at St. Roque would flow to the north or south. Hence the currents would, east of the coast, rush toward it, and west of the shore recede from it. It is, of course, the resistance of the coast which deflects the currents to the north or south. I beg to refer the reader to any map of the ocean currents with an application of these suggestions to facts, remembering these ocean currents would generally tend toward the eastern shores of the continents and recede from the western, modified of course by intervening islands.

The foregoing named forces are sufficient to account for all phenomena of atmospheric motion.

The general current of the air is toward the east, following the motion of the earth in that direction, but it lags greatly behind, — and there are, in any given area of the atmosphere moving eastward, internal motions in every possible direction, — so in a storm the winds from internal causes may blow in all directions, yet the superior force behind is constantly urging the storm area to the east.

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The prevailing wind in New Hampshire is the northwest. In the winter season this wind equals all the others. In the mountainous division of the state in the north the deflection is less to the south than the winds in the southern part.

There is of course a cause for this direction of the wind, being the resultant of all the forces. In the United States the storms start often just east of and near the Rocky Mountains, north or south of our latitude, and are followed by high barometrical pressure, coming in most cases from the Arctic Plain between the northern branches of those mountains and the waters of Hudson Bay, the resultant is the northwest wind pressing the storm to the east. It is observed, also, that many of the great storms swing around Lake Erie, and pass to the ocean, and then become subject to the Gulf Stream with a low condition of barometer, which deflects the western winds. These conditions with the monsoon per cent of deflection account generally for our prevailing northwest winds; and besides, the Gulf Stream flowing northward within two or three hundred miles of our coast with its warm waters, and consequently rarer air accompanying them, offers also an occasion for the northwest winds.

The Smithsonian department has published an elaborate work on the "Winds of the Globe," compiled by J. H. Coffin, LL. D., and completed on his decease by Prof. S. J. Coffin, and to this work (Vol. 20) I refer for data, with regard to the winds of New Hampshire.

The surface winds and the higher winds, as observed by the clouds, together average as follows in southern and central New Hampshire : —

SEASON.	Direction of Resultant.	Ratio of resultant to sum of winds.	Monsoon Influences.	
			Direction.	Force.
Spring	N. 67° 35′ W.	.23½	N. 85° E.	.07½
Summer	S. 67° 38′ W.	.26½	S. 13° E.	.19
Autumn	N. 75° 18′ W.	.28	S. 55° E.	.02
Winter	N. 57° 25′ W.	.49½	N. 34° W.	.22½
Year	N. 74° 9′ W.	.30		

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The average force of the wind is given for each season as follows: —

	Spring.	Summer.	Autumn.	Winter.	Year.
Average velocity of the winds per hour, in miles	7.77	5.57	6.37	7.72	6.86

The monsoon influences of course arise from difference of temperature in different seasons. In Asia, the monsoon winds are very important to commerce, and the ancient Greeks took advantage, not only in their commerce, but in wars, the winds blowing to the north in summer and to the south in winter. They arise from the first force suggested, viz., difference in the specific gravity of the atmosphere at different localities. The atmosphere in the equatorial Indian Ocean becomes heated in summer, rises, and the surface winds are drawn from the northern shores southward, and as the sun shines more direct upon the land in summer, that part becomes heated and the atmosphere rises and southern winds rush in to fill the place.

Prof. Coffin gives the force as 19 per cent S. 13° E. here in the summer, while the force of the wind is 5.57 miles per hour, and average for the year is 6.86. In the autumn, the velocity is 6.37 miles per hour, the interfering monsoon force only .02. We may now, following Coffin's data, trace an area of atmosphere fresh and moist from the Siwo Kuro or Japan Stream, across the Pacific Ocean in its flight eastward to New Hampshire, and still beyond. Landing on the coast of Oregon at Cape Blanco, it would rise above the Cascade range of mountains, and floating over them, and moving over their eastern valleys, deflected slightly to the south, pass over Idaho, and then reach the peaks of the Rocky Mountains, and with but little delay, pass their summits and onward over Wyoming, where, becoming colder and heavier, it would descend and become the surface winds of southern Dakota and Nebraska, and then moving over and parallel to the Platte, reach the Missouri with center near Omaha. A monsoon pressure from the south will then give it a slight movement to the north, and it passes swiftly over Iowa and northern Illinois to the region of the lakes. Its motion is now eastward over the southern lake territory to Pennsylvania, where, receiving an

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impulse from the south, again it moves northeasterly over and parallel to Lake Ontario to the Adirondacks. The Atlantic now invites it to its waters, and changing its course to the east, it flies over Vermont and then, with a slight change to the south in its course, comes to New Hampshire as a northwest wind, less deflected at northern than at southern New Hampshire, where it reaches the ocean. But it still moves onward to the Gulf Stream and, changing its direction, becomes a west wind and flies to and over Europe, then over Asia to the Pacific again. Its velocity is about 12° daily and its journey around the globe is accomplished in thirty days. It has the fate of the wandering Jew. It never stops, but is always moving and will travel its course forever. It follows the earth in her daily revolution, but with only one thirtieth of her speed. It passes over fragrant lands and lofty mountains. It kisses the summits of the Rocky, the Caucasus, and the Altai. It moves oceans to rage with its blasts and calms them again to serenity in gentle zephyrs. Lightnings flash through it, and it waves to the deep thunders of storms and the roaring of volcanoes, and we are breathing it to-day without a thought of its history.

The atmosphere not only moves but has weight. The barometer shows that a column of air is equal in weight to the column of mercury, 30 inches. The column of mercury often changes from 30.50 inches to 29.50 inches at different times, and that shows the atmosphere weighs less some times than others. Weight has power: it turns our wheels and spindles, simply by the fall of water — gravity. There is gravity in the air. We weigh the atmosphere with the barometer, we measure the heat with the thermometer, and the moisture of the atmosphere with the hygrometer.

Let me illustrate the weight or force of the atmosphere and I think we shall all understand it, viz.: We will suppose we are in a room ten feet in every direction, representing a cube, length, breadth, and height. We will now, with the air pump, exhaust the atmosphere from our room. If the air is entirely exhausted, the force or pressure of the air outside upon our room, if at its average weight, will be 15 pounds to each square inch on all of the six sides. We can compute the whole pressure very easily by reducing the six sides to square inches, and multiplying the sum by 15,

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viz.: 120 inches each way equals 14,400, multiplied by 6 sides equals 86,400, multiplied by 15 equals 1,296,000; that is, a pressure on the six sides of 1,296,000 pounds or 648 tons, or 108 tons on each side. Now if we open a space one inch square, the air would rush in with a tremendous force and would not cease to flow inward until the room was full again.

The air rushing to fill the vacuum we call wind, and here remember this force and condition; we shall need it in the whirlwind to which I shall introduce you. We understand why and how the air is put in motion. It is force generated in seeking an equilibrium. But the air has not always this pressure of 15 pounds to the square inch. It is lighter sometimes and again it is even heavier. The average pressure of the atmosphere at sea level at 32° of the thermometer is 30 inches, and if the barometer marks higher than 30, we call it high pressure, and usually if below 30, we call it low, but this is sometimes relative, for if the barometer is 29.50 at Chicago and 29 at St. Louis, we would say it was relatively high at Chicago. The weight of the atmosphere by the barometer in use is more conveniently expressed in inches.

It is found the general height of the atmosphere will sustain a column of mercury 30 inches high at the sea level, and the variations then of the column of mercury will indicate the variations of the weight of the atmosphere. If, then, the atmosphere be 45 miles high, and of equal density, one inch of the barometer would represent 1-30 of 45, or a mile and a half; and if the barometer should read 29 inches, it would represent the atmosphere 43½ miles high, so much in bulk, or perhaps in weight deducted from it. And, again, if the barometer read 30.50 inches, it would be 1-60 higher, or weigh more in that proportion. So when the air weighs more than 30 inches of the barometer, we say there is a high wave or high pressure, and if less than 30 inches, we say low wave or low pressure. Here we have a ready explanation of the terms high waves and low waves, as used in meteorological papers on the weather. You will see, then, when there is a high wave over our hypothetical ten-foot cubic room, there will be more pressure than 15 pounds to the square inch, and when a low wave is passing over it, the pressure would be less than 15 pounds to the square inch. The proportion of excess or loss is thus very easily ascertained.

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The weight of the atmosphere diminishes as we ascend, for the same reason, the higher we go, the less weight of air is there above us. There is not so much air above the summits of the White Mountains as there is at Portsmouth harbor, since the summit is more than a mile higher than the ocean.

According to Prof. Loomis, the fall of the barometer one inch represents an elevation of 917 feet; and so if at the base of a hill the barometer reads 30, and at the top 29, we conclude the hill is 917 feet high.

The aeronauts rising in a balloon can thus measure the height of their flight in this way. If one so rising should find his barometer had fallen five inches, he would be about 5,000 feet high. This will explain why and how the barometer is used in measuring heights of mountains as well as the weight of the atmosphere.

The barometer is read at the base and at the summit and calculations made accordingly. For greater accuracy other factors, such as temperature, moisture, and even latitude, are considered in estimating elevations.

Air in its movements is like fluids governed by gravity. If the barometer at Manchester read 29.50 inches and at Concord 30 inches, there is a depression at Manchester of one half inch compared with Concord, or a wave three fourths of a mile higher or heavier at Concord than at Manchester. In such a case wind would blow from Concord to Manchester. We find then the cause of wind to be the unequal pressure of the atmosphere shown by the barometer, and this law is established, viz.: *The wind always blows towards the center of lowest barometer.* If then the barometer is lower at Chicago and so all along the line to Boston, the wind will be easterly and blow all along the line from Boston to Chicago in that direction. As the wind blows in the channel of the lowest barometer, so the storm clouds once in that channel must travel in the track.

How are clouds formed, I may be asked. We know they are composed solely of water. We do not see the process of evaporation, yet we know that water steals silently away and hides unseen in the air. We see fog rising from bodies of water sometimes in the morning. As it starts upward it is invisible, but

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mixing with cold strata of air it becomes condensed and may be seen. Water boils at 212° and particles go off in steam. Some will tell us that evaporation is the dividing of the water in its smallest parts possible, when it becomes lighter than water and rises; but the belief that evaporation is the dividing of water into its gases, oxygen and hydrogen, and as hydrogen is the lightest gas known it ascends as a gas, is now generally abandoned. The molecule of water is small enough to make steam. It is estimated that any given column of the atmosphere may retain five inches and more of water in visible and invisible form at one time.

Moisture in the air in invisible form becomes visible at the dew point; that is, dew is formed in the atmosphere when the proper temperature for it is reached. Clouds then depend on temperature. The dew point on a fair day is several degrees below the general temperature of the atmosphere, and we know then the moisture is developed by a change in the temperature of the air. There is then a temperature which if developed in any room would cause the moisture to appear and envelop us all in fog, and that temperature is the dew point.

Let us apply this principle to two strata of air, charged with invisible moisture but differing in temperature. An area of atmosphere at a temperature of 60° from Concord blows down the Merrimack and in Manchester comes in contact with and becomes absorbed in an atmosphere of 80°, the temperature of the two would become equalized. The one would rise, the other fall, and in the fall of the temperature the moisture would be condensed into clouds. Hence, if we take 100 as the perfect saturation of the air, and find a per cent very near that, we know the atmosphere is so charged that very probably it will condense and fall in rain. This is one of the most important things to consider in the forecast of storms.

In the crowded assemblies in winter, if the windows are opened flakes of snow will fall into the room, though the sky be perfectly clear. It is not safe for one to sit near an open window who has not the strength to resist the effect of the moisture that would condense from the atmosphere around him. You will now understand what is meant by *dew point.*

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Here we come directly to the phenomena of the

AURORA BOREALIS,

which have caused much study and investigation, but with no very satisfactory results. The phenomena flourish in extreme northern and southern regions, but sometimes they light the sky in middle latitudes with many of the forms of the spectacular scenery of their more northern shows. The sun shining on the clouds, when dissipating mists, produces the rainbow to the observer; electricity playing upon the moisture just changing from the invisible to the visible, at the dew point, produces the phenomena of the northern lights. Two things are necessary for this display, viz., electricity and the dew-point condition of the atmosphere. Electricity is always in the atmosphere. It cannot be exhausted. If we credit those who have the charge of the dynamo-machine in rooms for lighting purposes, no marked difference is observed in the amount of electricity generated by a single dynamo-machine, or in a room full of them. The supply is constant, however much is generated there and sent off on errands of light. Hence, electricity seems to be a necessary constituent of the atmosphere. The clouds collect it in passing through the air, and again give it back to the atmosphere.

If one will watch the northern lights, he will observe at first a faint light at the north. The light will radiate from a polar center. It will soon grow dark at this center, and the lights will radiate from points in a circle around the original center. This center of darkness will increase and the circle of light will correspondingly increase until after a few hours the crown of light ascends nearly to the zenith, and clouds follow the crown at every point. We would interpret it as the result of conditions we have named, currents of atmosphere with different temperatures giving up their moisture at the dew point in such form as to collect the electricity present, and present radiations therefrom. If these conditions are extensive, a storm is sure to follow, not from the electrical display, but it is due to the clouds formed there at the dew point. I recur to an exhibition of northern lights some years ago, which I had occasion to watch. It was called a "magnetic" storm by the newspapers; it was in summer, a still

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evening, and the first part of it, I think, was cloudless. The sky was lighted finally in every part. I saw the little spectral clouds come from the invisible air like fancied ghosts lighted with electricity,; again, they and the electricity would disappear, escaping with a crack; the little spectral clouds had met a warmer current and had gone back to their invisible form, and there was no material for the electricity to play upon, so it escaped back into the air again. In this exhibition I estimate these little clouds were formed within one or two hundred feet of me, and the working machinery of the lights was plainly discernible.

In July, 1886, with several parties, one a reporter of a daily newspaper, I saw the same phenomena of the northern lights, and the same conditions were present, and the explanation of the phenomena of the aurora borealis was, that as the cooler atmosphere descends and comes in contact with the warmer strata of the atmosphere, the dew point is reached and the invisible moisture which the air contains is condensed into foggy mists and becomes visible. The electricity in the atmosphere charges these mists, causing them to become luminous. We have electricity, and it is not strange or new to us. It was once supposed lightning existed only in the clouds; but now it is generated every day, and we know dynamo-electric machines within the space of a common room could generate enough to give a brilliant light to every public building in our capital city and more. It is in the clouds and is generated there, and if the quantity is more than the clouds can hold, it will escape in the form of lightning. If there are better conductors than the atmosphere, it will escape noiselessly. It selects the path of least resistance and follows it wherever it leads.

"Lightning which accompanies these storms," says a circular issued by the late signal officer, Gen. Myer, "is the effect of the concentration upon large drops of water of the electricity previously distributed throughout the invisible vapor: it is considered as a result, not a cause of storms."

In June, 1752, Franklin proved that lightning and electricity are identical, and when we experiment with the Leyden jar at the laboratory the same phenomena occur that are exhibited in the thunder cloud, though immensely smaller. The sparks from the

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battery are a diminutive thunderbolt, and the electric light in our streets is the lightning made constant by the continuity of its production, the spark made continuous in its supply.

What is lightning, may be a pertinent question, but I cannot answer, nor can I quote the answer from the great students of the day. They can describe only its phenomena. It is a "mode of motion," some tell us. So is heat a "mode of motion." Light is a "mode of motion." In these definitions, the idea of motion only is given, but we have not yet the difference in modes of motion that explains either of the three. The definition is inadequate, but it is all we have to-day. We understand the cloud, but electricity is itself invisible except in its effects. Its touch may be fatal and we approach it with fear. Prof. Tait, a good authority, follows the conclusions of certain French savants, that as yet we know little or nothing of the origin of the manifestation of electricity. It would seem to be due to the direct influence of the sun's electricity upon the moisture of the air, or possibly to the indirect effect of the sun's heat, and this he and they regard as more satisfactory than the multifarious theories of friction, evaporation, condensation, etc. Is it not something shot out from the sun like light and heat, a force like them originating in the sun, known in its effects upon matter, though vastly different, to have the phenomena of light and heat in its work? It is one of that trinity, light, heat, electricity.

Treating electricity as a power, there are some units of measure we will study. It has units of force, quantity, velocity. The units used in the system of electro-magnetic electricity are, the *volt* as the unit of electro-motive force; the *ohm*, the unit of electrical resistance; the *ampère*, the strength of current produced through resistance; the *coulomb*, the unit of electric quantity, and the *farad*, the unit of electric capacity. These terms may seem cabalistic, but they are derived from the names of distinguished scholars and writers on electricity, — the names of Volta, Ohm, Faraday, etc.

We use horse-power as a unit of steam-power. The volt represents about the same idea in electricity as a unit of electrical force, and is a little less than the force of a cell of the Daniell Battery, — about 95 per cent of such cell.

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An ohm is a unit of resistance of the current, and is equal to the resistance of 100 yards No. 8 Birmingham wire gauge, — iron telegraph wire, — i. e., the resistance or friction the wire offers to the circuit.

The ampére is the strength of current produced through a resistance of one ohm by an electro-motive force of one volt, and decomposes 1.4472 grains of water in a second of time.

The coulomb is the unit of electric quantity. The number of coulombs passing through a conductor is equal to the ampéres multiplied by the number of seconds.

A farad is the unit of electric capacity. A body holding one coulomb of current, electro-motive force of one volt, has one farad of electric capacity.

A volt in power (like head of water), a farad in quantity, flowing through a telegraph wire 100 yards long, would equal the ohm or resistance (like friction in a tube of running water).

With these little units we may, to some extent, study the power and quantity of lightning. A volt would be greater or less than the quantity of the Leyden-jar spark, equal to about .95 of a Daniell cell, but for the purpose of illustration we will suppose them to be equal, the volt and the spark. If now we compute the area of the thunder clouds that pass over us frequently in summer, say three miles long and two miles wide, (not extravagant when we consider that the thunder roll continues often upwards of fifteen seconds without ceasing — in a shower August 23, 1885, I counted nineteen seconds of continued roll from one discharge), we find there would be an area of six square miles or 3,840 acres of cloud.

Dr. Faraday once showed that 6,500,000 discharges from a Leyden jar would suffice to charge a thunder cloud of thirty-five acres, and there is no authority better than his. Now one cloud of 3,840 acres fully charged would hold a hundred times as much as the one of thirty-five acres, or 700,000,000 of volts. We can have some idea of the immensity of quantity, as well as force, when we put to work 700,000,000 of Daniell's batteries.

We see how diminutive the lightning rod would be for the work of carrying off safely this immense quantity, when we consider that 100 yards of telegraph wire are necessary to the work of

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one farad per second for one volt. It would require a rod large enough to stand the resistance of 700,000,000 of ohms. In hardly an instance of a shower are lightning rods equal to the duty required of them.

Does lightning have any objective point at the flash? A cloud, like the Leyden jar, can hold only a fixed quantity, and when full its sparks are seen to fly away. So a cloud overcharged bursts, the air is a bad conductor, and the lightning seeks the easiest route to the earth. So the cloud does no wrong, it aims at no object. Let loose the lightning, it wildly runs where the least opposition offers.

Is it more likely to strike in one place than another? Apply the above rule and it would seem not. The course of the lightning must conform to the path of least resistance. This is verified by the conductor. It will follow a wire thousands of miles, while in air its travel might be only rods. As there are two kinds of electricity, the positive and the negative, and as *like* repels *like* and attracts the *unlike*, two differently charged clouds may unite. It appears, then, that the union of clouds may produce lightning.

Experiments show different results in the velocity of lightning. The coast survey experiments show its velocity to be from 20,000 to 25,000 miles per second over iron wire, while some electricians have estimated it to be 194,000 miles per second, or greater than that of light. There are no settled data as to its velocity. The question is sometimes raised as to the possibility of a person struck by lightning seeing the flash. Air is a poor conductor of electricity, and it would doubtless be slower than light, so there would be a glimmer of light to the one struck, but the difference would be the small fraction of a second. As a general rule if the person sees the light of the bolt he is safe.

Are all persons liable to be struck? To say no would hardly be true, but some persons are more likely than others to feel the effects of electricity. The mother, with a child sleeping in her arms, has been killed and the infant saved. Persons in the same room, even in the same bed, are differently affected. A young girl in Manchester during a thunder shower could not control her hands; the fingers would be drawn together and her limbs suffer

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the pains of cramps. Some will be sleepy, some nervously excited and unable to control their feelings. Such persons are really affected physically by electricity, by what is called *induction*, and persons are more or less influenced by every thunder cloud coming near them. If a cloud charged with positive electricity should pass over a person negative in electricity, he would feel the influence. Persons have stated that they were sensibly affected by certain thunder-showers in a manner they never experienced before, and others, who at times were affected, state they were in a measure free from the excitement. This is satisfactorily explained by the view taken here, that all are more or less affected by clouds charged with lightning, and are consequently subject to influences they cannot control, by the like or unlike form of electricity in them and in the clouds.

Lightning, then, we say, is the escape of electricity from the clouds, like electricity from the Leyden jar. The explosion is thunder. But why do we have the long peals of reverberations, seeming sometimes distant, coming near and then rolling away, finally disappearing in the distance? This is very easy to explain if we recall the fact that sound travels at the rate of 1,142 feet per second, while the discharge from the cloud may be a mile or more like chain lightning, so there would be a continuous roar until the sound from the most distant point of discharge had reached us. For example: If a cloud extending from a point two miles away from us become charged with electricity, should discharge throughout its whole length in chain lightning, we should first hear the explosion immediately over us, and then it would be followed by a continuous sound as reports along the line came to our ears traveling at the rate of 1,142 feet per second, or a mile in some five seconds, until the most distant discharge reached our ears, lighter or heavier according to the severity of the discharge and the distance of the cloud from us. This roll of thunder then is due entirely to the tardy travel of sound, while the flash of lightning is quick as light.

The flash of lightning, it is said, is the heating of the constituents of the atmosphere to incandescence. Ball lightning, often following heavy discharges, has astonished everybody, but is now generally believed to be the constituents of the shower in gas or

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air solidified and heated to incandescence. M. Planté, the well-known French electrician, has been led to experiments in which a successful imitation of ball lightning has evidently been obtained. With a powerful current from secondary batteries, it is said he has produced in an air condenser, formed of two moistened pads of filter paper placed near together, a small incandescent globule, lasting some minutes and moving slowly in a curious and most erratic path. When a condenser was used in which the insulating material was ebonite, a sound was emitted like that of a toothed wheel rapidly rotated against a piece of cardboard.

On August 22, 1885, at Perry, N. Y., during a violent electric storm, lightning struck a dwelling-house; a newspaper commenting on the fact says: "A ball of fire two inches in diameter, it is said, went in through the roof and rolled over the carpet. The occupant, in his bare feet, sprang upon theball and crushed it out. His feet were terribly burned, and he received a shock from which he did not recover in several hours. His escape from instant death is considered remarkable."

But frequently hail falls in the shower! What is hail? Hail is frozen water. The form of the hail particularly attracts our attention. The smaller, more or less globular, we call sleet. There sometimes fall irregular masses like pieces of ice frozen together, and there are round hail-stones, sometimes with several layers like an onion. In a shower on the 3d of July, 1885, the hail fell in such quantity in Sandwich, N. H., that it was used in refrigerators to make ice cream in celebrating the next day (the 4th). Prof. Loomis says: August 13, 1851, about 1 P. M., hail-stones fell weighing 18 ounces, and to the depth of 4 inches, in our state; and the same year, in India, hail fell about the size of oranges. If we examine them we find them to be ice in every form of congelation, — the pure and transparent, the hard and soft. What astonishes about it is, that in a summer day, with the thermometer 75° or more, such ice globules could form in the atmosphere. Here is the phenomenon, how shall we explain it? This fact is evident, — that somewhere in the fall of the hail it has passed through an area of air at or below the freezing point.

Through the efforts of the British Scientific Association, the

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average temperature of the atmosphere, some 25,000 feet upward, was found to be as follows: For the first 5,000 feet the thermometer fell 1° for each 239 feet in a fair day, and 271 feet in a cloudy day; for 10,000 feet, it fell 1° for each 394 feet; in 15,000 feet, it fell 1° for each 490 feet in clear, and 459 in cloudy. The difference, then, between the surface and 15,000 feet high would be about 45°. So, while the temperature at the surface was 75°, it would be 30° at the elevation of 15,000 feet, a point 2° below freezing. Prof. Loomis says the average summer temperature at 18,000 feet elevation is 20°, which is 12° below freezing. The cirrus cloud lives and moves at that altitude, and even higher. Hail is found in the Alps at 16,000 feet. Now, if a stratum of that cold atmosphere should come down and mingle with the lower raining clouds, making the same below the freezing point, we would expect the rain to be frozen into ice or hail; and, again, if the raining clouds should be transferred to the higher, colder stratum, we would also expect the rain to be frozen into hail. These possibilities depend on vertical currents of air. Now, if there be two strata of clouds charged highly with moisture, one above the other, and the lower raining freely, it would necessarily create a vacuum, and cause vertical as well as lateral currents to rush in to fill and supply the vacuum, and if the upper cold currents came down, hail-stones would be the result. The hail may start from a higher elevation so cold as to freeze to itself the moisture it meets on the way in layers, or even angular pieces. The hail area of a storm in summer is comparatively small. We have, then, only to find a force capable of drawing down the upper currents of cold atmosphere and hail-stones in mid-summer, and our phenomena are explained. This occurs in whirlwinds, and we will now speak of those.

The whirlwind is the most powerful because the most destructive to life and property of all atmospheric disturbances. The name describes them, — whirling wind, with the clouds in its control. In the cyclone, or whirlwind, there is no new power, but additional force is generated. Two things are necessary, not including the prevailing wind that gives movement to the whole mass of clouds, the rotary and additional force in the wind.

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This movement is limited to a small area of the storm clouds, sometimes only a few rods, or even feet. How is this great force produced? This mighty force of whirlwind and tornado must be generated out of or by the clouds, under the laws of heat and electricity.

We have now studied the various conditions and forces that are incident to the atmosphere and liable to develop there, and we will now apply them in the thunder storm, hail storm, whirlwind, or cyclone, and I will begin with the simplest formation.

We may see in a summer's morning dense fogs rising along the streams and at the base of the mountains, obscuring the hills and forests from sight which but a moment before presented themselves boldly to our view. The sudden change from clear to foggy, misty weather, is striking, and we have to suppose some new conditions have appeared to disturb the air, and we begin to think these sudden changes are the premonitions of a storm. These premonitions soon become verified by the abundance of clouds. The fog rises and collects in bunchy masses, not very high, but above the ordinary hills, and then rises higher and higher, until the mountains, previously obscured, are distinctly in view, from top to bottom, and the clouds sail majestically above them. These foggy masses have become the *cumulus*, assuming an importance sufficient to merit a name, by their significant importance in the disturbance we now expect, and which has already begun.

Let us now watch them. If they remain isolated and sail in the air alone, they will soon pass out of sight or fall back into the air again in invisible moisture. They do not act in that way. They are growing larger, darker, and they approach each other and unite into masses. Then follow these conditions: The wind ceases, the smoke from the chimney ascends perpendicularly, the clouds seem to stop in mid-heavens and hang motionless above us; but the stillness is momentary, for they soon begin, as with some hidden impulse, to move around a common center. They grow thicker, larger, darker, and they become massed together and fill the whole sky. Some have coppery edges, while others shine like silver, and they are drawn together and become so black that their shadows cover the land,

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and the sky is completely hidden from view. They soon become electrified, uniting into closer and denser masses than before. We see then a flash; it is noiseless, but shows the grim form of the shower ready to burst upon us. The harmless fog ascending forms the cumulus, and the cumulus is transformed to the nimbus. We look for the cause of these. There is a slight change in the thermometer, the barometer, and the hygrometer, showing change in the temperature, the weight and moisture of the atmosphere. From experience we know what to expect. We examine the hygrometer and find the humidity is increasing, and that the dew point and temperature are very near the same degree. The clouds now move round a common vortex, and anon there is a murmur of the wind, now a flash, followed by immediate thunder, which announces the shower, and it rains. The clouds now fall into the track of the wind and move with it. So far it is a simple shower; but there accompanies the shower lightning, and there are also hail and the whirlwind, for they, too, are conditions of our summer shower. There must be wind (we have already the other factors), and if a vacuum of one fifteenth of the atmosphere is obtained we can see how the wind is to be produced. To understand better, let us go back to a few first principles.

1. Water converted into steam expands to nearly 1,700 times its volume, and this expansion requires heat.

2. Steam or vapor in condensing to water gives back that heat.

To make a figure, water borrows heat and with it swells to vapor, and in paying back the borrowed heat it dwindles down to water again.

Clouds are condensed vapor, and water changed to clouds does not expand so much. It is estimated the atmosphere will hold, in various forms, five inches of water. Communicate heat, 212 degrees, to water, and it is converted into steam. The different densities of clouds, even in the same shower, are such that an estimate only can be made of the expansion of water to the cloud form. It may or may not equal 1,000 times its bulk.

These principles of the expansion of water and condensation of vapor being recognized, we will apply them to a given cloud, say of 17,000 cubic feet in a space of 17,000 cubic feet of atmos-

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phere. It is so dense, so heavy with moisture, that it falls to the ground of its own weight, and is in the condition we left it after the hail storm ceased to interest us. We have wind, rain, and lightning now playing their several parts in the storm. The rain is heavy, and the condensation amounts almost to a collapse of the cloud, and it shrinks to 1,700 cubic feet, one tenth of its bulk; at the same time it is incapacited, in consequence of its reduction, from holding the electricity it had gathered, and the lightning bursts from every part of the shrinking cloud, and heats the gases and the air to the highest degree. Only one tenth of the 17,000 cubic feet of the cloud remains, and now we discover the vacuum we were expecting.

We examine the barometer and find it has fallen from 30° to 28°; one fifteenth of the whole atmosphere is eliminated. The force we find to be 144 pounds to the foot, and a velocity of 170 miles per hour.

This is again announced to us in the falling torrents of rain, the terrific flashes of lightning, and the thunder muffled by rain and wind which now assumes control of the storm. A partial vacuum of the air to the extent of one fifteenth summons the forces of nature to its aid, and the whirlwind is the only relief it gives; but it is sufficiently potent. The old cloud of 17,000 feet destroyed, others rush to fill its place, while the air is reduced in density, and, becoming rarefied still more by the intense heat of the lightning, rises with the velocity of the wind a distance above. A whirl is now formed around the center of rarest air, the general current of the wind first giving the direction of motion, and as the new clouds fall into its vertex they are stripped of their moisture and electricity, and the rarefied air that held such is sent whirling above, to be followed by other clouds in their turn, and the work of destruction and repletion becomes continuous. It moves along the ground, sweeping trees and houses, and everything in its course must yield to its tremendous power; a power we can only in part estimate in figures, because the force of electricity cannot be measured, and it will continue till this partial vacuum, this depression, be filled, but never long. If this whirlwind should extend to a body of water it would raise waterspouts. Such are common in hail storms. In elevated places it

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assumes a form of whirl about a horizontal axis, showing the upward and downward motion of the air.

We have now seen how the fog and moisture of the morning are formed into clouds, and clouds into showers; how lightning accompanies the shower, that the rain may be changed to hail, and that the shower of the summer may be converted into the cyclone, all by the action of forces necessary and present in the atmosphere at all times and in all places.

PROTECTION FROM LIGHTNING.

In 1885 the spires of three churches in Manchester, one in Candia, and one at York, Me., were struck by lightning and destroyed or greatly damaged. On the 31st of July a gentleman saw a bolt descend over Manchester and divide in three parts, and at the same discharge the Franklin-street church and two private houses were also struck. This led to a correspondence with Prof. William M. Davis, of Harvard College, secretary of the New England Meteorological Society, and Prof. Alexander McAdie, also of Harvard College, and an electrician of the United States Signal Department. Prof. McAdie writes: "Prof. Upton has asked me to write you with regard to your letter to him about the material and arrangement of spires that shall be proof against lightning. The iron spire is the very best protection against lightning, always provided the metal does not stop half way down, and even then if it is connected with damp earth by an iron rod one inch in diameter, or a copper rod one half inch in diameter, there is perfect safety. I have been called upon to inspect a great many lightning rods, and in about nine cases out of ten the connections were defective. Memorial Hall at Cambridge, Mass., has a vast amount of metal in the spire. It is two hundred feet high, and this stops half way down, but the connections with the ground are ample and kept in good condition, and there is no thought of danger."

Prof. Davis responds as follows, referring to English reports: "The most essential matters in the construction of a lightning-rod are its continuity, its immediate connection with the building, especially with the building and metallic objects in its upper part, but not with the gas pipes, and, most of all, its exten-

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sion downward into the ground so as to meet permanently with wet earth. The rod is best of copper, weighing not less than six ounces a foot, made in the form of a flat tape or a rope of stout wires twisted together. If not a continuous piece, its joints should be cleared and well soldered. The upper end should not be very sharply pointed, but about a foot from the top attach a copper ring, and from the ring let three or four sharp copper points about six inches long incline outward from the rod. The top and points should be plated to prevent rusting. The rod should be fastened directly to the building by metallic holdfasts. Glass insulators must not be allowed. The church bells need not be connected. The rod should be taken down the rainiest side of the building. It should have no abrupt turn. All ironwork on the roof should be connected with the rod. If the ironwork is in separate parts, every part should be connected by metallic rods with soldered joints. The rods should be well grounded in wet earth. It may be into the water of a good well, or be soldered to iron gas or water pipes under ground, or it may connect with a sheet of copper three feet square and one sixteenth of an inch thick, buried in permanently wet earth and surrounded by cinders or coke which hold moisture. The best rod is perfectly useless if it is in dry ground."

Upon the foregoing instructions we may say, wires or rods so arranged insure safety to property and life. My experience is, that three continuous copper strands, perhaps one fourth inch in diameter, twisted sufficiently to be firmly connected, make not only the best but the cheapest rod for a long time, that can be constructed. Measure the height of the building, allowing a few feet above and then under ground to some brook or pond never dry, or moist earth, and there is protection. This is not expensive, perhaps twenty to thirty dollars for each hundred feet, according to the weight of the copper wire. Far better and safer to have no rod than to have an imperfect one. The whole worth of the rod is in the manner of putting it on a building. These instructions were followed in connecting the new spire of the Franklin-street church by three copper strands twisted with the moist ground.

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FOREIGN FRUITS.

Our fruit-growers are taking an unusual interest in foreign varieties, and especially those adapted to our northern latitudes. Our Canadian brothers have tested Russian varieties, often with success, and efforts in the same direction have been made in our own state.

In a former volume we presented liberal papers on Russian apples, from the reports of Messrs. Gibb, of Abbotsford, P. Q., and Prof. Budd, of the Iowa Agricultural College, who visited Russia and thoroughly studied the nature of many of the fruits of that northern country.

We again venture, without asking permission of the author, to copy his report on the "Fruits of Wurtemberg." He gives not only his own opinion, but also those of the best pomologists.

THE HARDY FRUITS IN WURTEMBERG.

BY CHARLES GIBB, ABBOTSFORD, P. Q.*

In Europe, pomology is studied as a science, and men attend schools of pomology just as they attend schools of law or medicine in this country. When Prof. Budd and myself, in 1882, were on our way to Russia to look up the fruits of the cold climates of the old world, we staid at several of the pomological schools, noted their opinions of their best fruits, and, as far as we could, formed our own. The late venerable Dr. Lucas, who died in 1882, made fruits the study of his life. He gathered at his

* From the Report of the Montreal Horticultural Society.

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pomological school at Reutlingen all the good varieties he could get hold of, tested them in his grounds, and recorded his opinion on them. The two winters preceding our visit had been unusually severe and the Wurtemberg orchards were seriously injured. What varieties had stood this test was the question we specially asked. Mr. Fritz Lucas had grown up surrounded by rare opportunities, and such opinions must help to guide experimental work into profitable channels.

APPLES.

LATE WINTER VARIETIES.

Baumann's Reinette. Mr. Fritz Lucas describes this as a large and very beautiful and good fruit, in season from winter until the following summer. The tree is productive and the fruit valuable for the market. Prof. Dr. Rudolf Stoll, of the pomological school at Klosterneuburg, near Vienna, in his beautifully illustrated work, the "Œsterreichisch-Ungarishe Pomologie," describes this fruit, a medium-sized, flattish, conical apple, entirely covered with dark carmine, in which some darker stripes may be noticed. The flesh is yellowish white, fine in grain, and moderately juicy, with a very agreeable wine-like sugar flavor. The fruit ripens in December and keeps until mid-winter, and for market and home use is a most valuable kind. The tree thrives well on dry soils and in bleak exposures, and, moreover, bears early and abundantly. According to the "Illustrirtes Handbuch" by Lucas & Oberdieck, this variety should not be absent from any garden.

Mr. W. Lauche, Royal Garden Inspector of Berlin, in the "Deutsche Pomologie," a work which gives full descriptions and beautiful colored plates of fifty of the best varieties of apples for Germany, describes this apple. It was grown by Van Mons, and named in honor of Napoleon Baumann, proprietor of the nursery in Bollweiler in Alsatia. At the seventh assembly of German pomologists at Trier in 1874, it was named among the fifty best varieties, and at Potsdam, in 1877, included in the list of ten best varieties for cordon training. It deserves to be in general cultivation for its productiveness, beauty, and quality. The flesh is yellowish white, fine-grained, very juicy, and of a peculiar

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vinous acid and spicy flavor, and is useful both for table and for cooking. It is in season in December and keeps till March. The tree is vigorous in growth, but not large. It is uncommonly fruitful, and flourishes in any good soil, and does not lack hardiness.

Boikenapfel. Mr. Lucas says that this is a remarkably fine fruit for kitchen or for table. The tree is a young and abundant bearer and bears well in unfavorable places. Mr. Lauche says that this is a common apple tree in the neighborhood of Bremen, where it has been highly prized for a long time. It is said to have been named *Boiken*, after a former official. Oberdieck called attention to it at Berlin in 1860, but it was for the first time included in the fifty best kinds at the meeting at Trier. In Germany it is not widely distributed as yet, but deserves to be. The flesh is snowy white, fine-grained, juicy, of an agreeable spicy, vinous, acid flavor. It ripens in the cellar in January and keeps till summer. A very good cooking apple and in summer an agreeable table fruit. It thrives on all kinds of soil and on every exposure. The tree is very healthy. It blossoms very late and bears well.

Dr. Stoll also gives a description and a beautiful plate to this apple. He describes it as a clear yellow in color, with more or less blood-red on the sunny side. It seems to be a fruit of rather large size. Dr. Stoll's account of it agrees with that of Mr. Lauche, and says that if properly stored it will keep till the following summer. For the market, it is difficult to find a "better constructed" apple, and its quality and its long-keeping properties impart to it extraordinary value. The tree bears almost every year. It is not sensitive to bleak exposures, and grows well even in rather dry soils.

Bretagner Reinette. Mr. Lucas says that this is a very beautiful and delicate apple, a red reinette of large size and unusually fruitful. It ripens in November and keeps till March.

Danziger Kantapfel. Mr. Lucas mentions this as an eminently large, dark red apple for table and kitchen use, a good bearer, and in season from fall till winter. Dr. Stoll describes it as an apple "built on the Calville principle," with characteristic ridges running from calyx to stem. Flesh very fine-grained, full of

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juice, and, as Oberdieck says, it has a delicately flavored, refined acid sugar flavor. It ripens about the middle of October and keeps till February. When fully ripe it is a very fine table apple and one of the best for cooking, and Lucas recommends it strongly for fruit wine. Although this delicate fruit bruises readily, these bruises are not apt to cause decay. The tree thrives well in bleak situations and in any good soil, and, when well grown, is very fruitful.

Mr. Lauche says that the origin of this apple is not known. It has been distributed for a long time under most diverse names in Holland and Germany, and was recommended for general cultivation at the first meeting of German Pomologists at Naumburg. Mr. Lauche's opinion agrees pretty much with that of Dr. Stoll.

Grauer Kurzstiel (Carbanter). The Gray Short-stem, Mr. Lucas says, is a much-prized apple, either for table or cider, and that the tree is very hardy and a good bearer. Season, winter. Dr. Stoll gives this as a synonym of the *Königlicher Kurzstiel* (or "Court pendu rouge"), which is pictured and described both by Dr. Stoll and Mr. Lauche as a medium-sized, flattish, attractive reddish yellow apple "of noble, peculiar, spicy, Reinette flavor." It is of fine quality and keeps till March. Mr. Lauche says it was described in 1613, and has been very widely distributed.

Grosse Casseler-Reinette. Mr. Lucas says that this is a large, beautiful gold-reinette. This tree is unusually productive. The fruit is very fine for table and for cider, and keeps for a year. Messrs. Simon-Louis describe it as rather large, roundish, stained and striped with crimson on dull golden ground; flesh fine-grained, firm, sugary, and of very agreeable flavor; of first quality for table or cooking. Season, during winter and spring. The tree is vigorous, bears early, and is very fruitful. A variety universally appreciated.

Königin Olga-apfel (Queen Olga). Mr. Lucas says this is a magnificent and a very good and fruitful Borsdorf-Reinette from the Ukraine. The tree is a very strong grower, and hardy, and very much to be recommended.

Luxemburger Reinette. Mr. Lucas says is a large, beautiful, and good yellowish green Rambour-Reinette. Tree very hardy, and fruitful. Season from winter till the following summer.

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Œlkofer Pepping. According to Mr. Lucas, a small, delicate, very beautiful winter apple. Tree of medium size and very hardy and very fruitful. Messrs. Simon-Louis in their "Guide Pratique" describe the Pepin d' Œlkofen as a fruit like the Pepin d'or, but a little larger. Flesh crisp, very juicy, of first quality, and ripens towards the end of winter and spring. Tree a slow grower, but very productive. I may add that this "Pepin d'or" is the *Pepin d'or de Bull*, that is "John Bull's Golden Pippin."

Purpurrother Cusinot. Mr. Lucas says, very valuable and a good keeper; tree strong, durable, and very fruitful. Mr. Lauche says that this is of German origin, and that it is distributed under a great many names, especially in Brandenburg and Hanover. Oberdieck drew attention to it as an unusually fruitful cooking apple at Gorlitz, but it was for the first time included in the fifty best kinds at the Seventh Assembly of German Pomologists at Trier. The flesh is yellowish white, often stained with red, fine-grained, juicy, and of a vinous acid sugar flavor. An extra good cooking apple, also esteemed as a dessert fruit. It begins to ripen in the cellar in December, and keeps till summer. The tree grows rapidly, it is unusually fruitful, flourishes in every kind of soil, and can be recommended for bleak exposures.

Dr. Stoll indorses its good qualities and speaks of it as a fruit for home use of the highest usefulness. Its great productiveness, bearing nearly every year, makes it a friend of inestimable worth to the countryman. The fruit, although not first-class for the table, is first-class as a market apple and for drying and cider. The fruit is sent every year into the markets of Prague, Breslau, Berlin, etc., by thousands of cwts. The tree is not sensitive to unfavorable climatic influences. As pictured by Dr. Stoll and by Mr. Lauche this is an unusually attractive dark red apple, and there seems to be no difference of opinion as to its general useful qualities.

Rother Eiserapfel. Mr. Lucas says a good medium-sized apple that keeps for one year. The tree is a strong grower, and very hardy and fruitful. Mr. Lauche states that this is of German origin, and that as early as the sixteenth century it was extensively grown around Bamberg and Nuremberg, and that it is widely distributed through Germany. At the Second Assembly

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of German Pomologists at Gotha in 1857, it was recommended for general cultivation. The fruit has a yellow ground mostly covered with dull red, and in flavor is a somewhat sweetish vinous acid, first-rate for cooking, and also "agreeable for raw enjoyment." It begins to ripen in January, and, when properly stored, keeps through the entire summer, and hardly ever spoils. It bears very heavily, flourishes in bleak exposures and in every kind of soil, provided it be not too dry.

Dr. Stoll also pictures and describes this fruit, and says that it ripens towards Christmas, and keeps till harvest, but is rather mealy then. On account of its long keeping it is a treasure to apple-growers, but it is not desirable as a table fruit until all other kinds have become scarce. It should only be planted in damp soils, and then is one of the best commercial apples. Dr. Stoll says this is the apple described by Dr. Hogg in the "British Pomology" and in Downing's "American Pomology" as "Court pendu plat." I will add that an apple under this name has done well on the College Grounds at Ames, Iowa.

Rother Winter Himbeerapfel. The Red Winter Raspberry is mentioned by Mr. Lucas as a noble large red Calville. The tree is of medium size, very fruitful, and hardy in bleak exposures. Messrs. Simon-Louis give this as a synonym of *Calville Rouge d'Hiver*, a fruit of rather large size, variable in form and ribbed, and almost entirely covered with red of one shade. Flesh stained with red, tender, with a perfume like the strawberry. Of first quality for table or kitchen. Season, winter. Tree moderately productive and vigorous, but does not do well in clayey or moist soils. Dr. Stoll also praises the Calville Rouge d'Hiver in very high terms, and says it is specially suited to connoisseurs of fine dessert fruit.

Weisser Winter Taffetapfel. Mr. Lucas notes this as a beautiful small apple, pleasantly acid, very fruitful, and in season from fall till winter. Dr. Stoll speaks of the beautiful wax-like skin of this apple, its fine quality, and the high price it commands in the Vienna market, and its value for cider, drying, and preserves. It begins to lose its fine table qualities towards the beginning of the new year. This apple, it would seem, has neither the size nor deep color nor keeping qualities to commend it for special trial in this country.

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Zwiebel-Borsdorfer. Mr. Lucas says a good apple for table or cider. Tree of middle size, hardy, and fruitful. Season from November till February. Messrs. Simon-Louis state this to be a synonym of the *Borsdorf-Ognon.* Fruit, they say, small, the shape of an onion, a pale, clear, brilliant yellow. Flesh very fine, firm, mild, very sugary, and of very fine flavor, excellent. It ripens during winter. A singular but beautiful fruit.

PEARS.

The question we asked about pears was: What are your *hardiest* kinds, those that have stood the most trying winters without regard to quality? The answer was given in the following list of nine varieties, the first four of which are dessert fruits, and the remaining five of use for cooking and cider only.

Madame Favre. Mr. Lucas says of this, a large, roundish beautiful, and fine fruit. Tree very stocky in growth and very fruitful. Messrs. Simon-Louis describe it as a rather large, rounded, and ridged fruit; greenish yellow, stained with grayish red and washed with vermilion. Flesh very fine, very juicy, very sugary, and deliciously perfumed; of first quality. Ripens at the beginning of September. Tree vigorous and productive.

Triumph von Jodoigne. Mr. Lucas says a very large pear, clouded red. Season, winter. The tree is very vigorous in growth, and is suited to moist soils. Messrs. Simon-Louis describe this in their list of "first series of merit." Fruit large or very large; pale greenish yellow, sometimes washed with red, half buttery, juicy, sugary, and of agreeable perfume. Season, end of autumn. A very beautiful fruit of variable quality.

Windsorbirn. Mr. Lucas says a really good, rich, juicy, summer pear. The tree makes vigorous growth, and bears young and abundantly. Dr. Robert Hogg in the "Fruit Manual" says that the Windsor (perhaps the above) is undoubtedly of foreign origin, and that it is shipped in quantity to London from Oporto, and is a summer pear of fine quality.

Ulmer Butterbirn. Mr. Lucas says a delicate, medium-sized, egg-shaped, very beautiful pear. The tree is a handsome grower, hardy, and abundant bearer. Season, October. Messrs. Simon-

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Louis state that they received this from Würtemberg. Fruit medium in size, egg-shaped, very pretty, of first quality. Season, October. Tree vigorous, hardy, and very fruitful.

HARDIEST PEARS FOR COOKING AND CIDER.

Betzelsbirn. Mr. Lucas says a very good pear for cooking and cider and preserves, nearly medium in size. Tree a good grower and fruitful. Season, November and December. Messrs. Simon-Louis describe it as a roundish, yellow fruit of medium size; for cooking and for cider. In season from January till April. Tree large and very hardy.

Grosser Katzenkopf. Mr. Lucas says a very large, roundish, rusty, spotted cooking pear. Tree very vigorous, hardy, and very productive. Season, January to February. Mr. Lauche says that this pear had its origin in Germany, and that it can be traced back to the sixteenth century. About 1590 it was propagated in the Bamberg nursery schools, and was brought by local dealers along with other varieties into Saxony, Thuringia, Hanover, and Holland. Thence it was without doubt brought to Cadillac, whence it received its name. At the First Assembly of German Pomologists, in 1853, at Naumburg, it was recommended as a commercial fruit for general cultivation. Dr. Stoll says that this fruit is often of enormous size; flesh firm, very coarsely granular, slightly astringent, and without sweetness or aroma, but not bad after all, though sometimes absolutely unenjoyable. However, in 1881, apart from its beety character of flesh, it was on the whole agreeable. Tree vigorous, very productive, and seems little susceptible to soil and climate.

Grosse Rommelter. Mr. Lucas says a medium-sized, round, green fruit, good for cider. Tree vigorous, and an unusually heavy bearer, and thrives almost anywhere; season, October. Messrs. Simon-Louis say fruit of medium size, round, green; of first quality for cider; season October. Tree very vigorous, of extraordinary fruitfulness, and succeeds everywhere.

Ochsenherzbirn. Mr. Lucas says a very large and beautiful cooking pear. Tree large, very stocky in growth, and very fruitful in rich soils; season, October and November. Messrs.

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Simon-Louis describe this, under the name of *Cœur-de-Bœuf*, as a very large pyriform pear, largely washed over with dull red. Season, autumn; use, cooking. Tree large, vigorous, and very fruitful.

Weiler' sche Mostbirn. Mr. Lucas says a small greenish-gray, roundish pear, very bitter, but up to the present time the best of all known pears for cider. The tree is an abundant bearer, is a vigorous grower, very hardy, and thrives almost anywhere. Season, October.

PLUMS.

The plums of Western Europe as a rule do not give good satisfaction in our climate. They do sometimes bear heavy crops, but not regularly, and the trees are not long-lived. The prune plums, as a class, are noted in Western Europe as hardier than the ordinary plums, and in Eastern Europe, in the cold climates of Moscow and Kazan, the plums grown are mostly of the prune type. In Europe these types are recognized, and catalogues head their lists, "Pflaumen und Zwetschen," and men plant out orchards of Pflaumen or Zwetschen, just as in California they set out their acres to raisins or grapes. I shall describe them in alphabetical order.

Esslinger Fruhzwetsche. Mr. Lucas says a medium-sized fruit of remarkable beauty. The earliest and best of prunes. Tree exceedingly fruitful and very highly recommended.

Frankfurter Pfirsich-Zwetsche. Mr. Lucas says a remarkably beautiful prune for dessert. Tree very fruitful.

Fruhe Reineclaude. Mr. Lucas says a beautiful fruit, very similar to the Grosse Reineclaude, but ripens fourteen days earlier. Very productive. Season, middle of August. Messrs. Simon-Louis state this to be a synonym of the *Reineclaude Davion*, which they describe as a medium-sized, roundish fruit, mostly rose-violet in color, and of first quality. Season, end of July. Tree a moderate grower, a young and abundant bearer.

Graf Althanns Reineclaude. Mr. Lucas says a specially beautiful, clear-red plum. Extra good and very fruitful, a new variety; ripens beginning of September. Messrs. Simon-Louis speak in high praise of this variety. It originated in Bohemia, and is as yet rare. It is of the highest order, according to the

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reports we have of it, and its varied good qualities unite in declaring it without an equal among table plums. On account of the firmness of the skin and flesh it is specially fit for shipment.

Grosse Reineclaude. Mr. Lucas says the most prized and the best kind of plum. Very valuable for table or cooking. Season, end of August and beginning of September. Messrs. Simon-Louis state this to be a synonym of the well-known *Reineclaude*, which they say is, of all plums, the finest in quality, but variable as to yield and vigor of tree.

Italienische Zwetsche. Mr. Lucas says a very large and a very fine plum for the table or for drying, in season from the middle to the last of September. The tree prefers rich, moist soil. Messrs. Simon-Louis mention it as a precious variety for for favorable localities, and not suited to cold soils.

Kirk. Mr. Lucas says a very large and a very good dark red plum, in season during the first half of September. Tree uncommonly fruitful. Messrs. Simon-Louis speak well of this variety. They say, fruit large, violet-black, juicy, very sugary, and perfumed; ripens the end of August and beginning of September; a fine and excellent plum. Tree vigorous, hardy, and fruitful. Dr. Stoll also describes and pictures this plum, and says fruit large to very large, holds well on to the stock; dark violet, covered with light blue bloom; flesh firm, overflowing with juice, sugary sweet, with a delicate, aromatic flavor; a magnificent table and market fruit, which ripens during first ten days of September. Tree vigorous, very fruitful, and not sensitive to soil and climate.

Montfort Pflaume. Mr. Lucas says a large, blue-black, roundish-oval plum, very delicate. Tree very fruitful; season from middle to end of August. This is indorsed by Messrs. Simon-Louis.

Spate Muscateller Pflaume. Mr. Lucas says a large, oblong, bluish-black plum of fine quality. The tree is very productive; season, middle of September. It is described much in the same way by Messrs. Simon-Louis.

Schone von Lowen (Bellede Louvrain). Mr. Lucas says a very large and beautiful reddish-blue plum; egg-shaped. Tree very vigorous in growth. Season, September 1. Messrs.

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Simon-Louis state it to be of pretty good quality for the table and first-rate for cooking. It recommends itself on account of its beauty and its tendency to hold on firmly to the tree.

River's Fruhpflaume. Mr. Lucas says a very early and good and medium-sized plum. Tree very hardy and fruitful. In season till the end of July. Messrs. Simon-Louis say fruit small, almost round, reddish-black; fine, juicy, sugary, and agreeably perfumed. Ripens the middle of July. Tree vigorous when young, but comes early into bearing, and remains small. The best of the very early plums.

Reineclaude von Quillins. Mr. Lucas says a large, roundish, yellow, very good and beautiful fruit, as large as the Grosse Reineclaude and just as fine. Season, middle of August.

Wangenheims Fruhzwetsche. Mr. Lucas says a medium-sized, oval, dark violet prune. Tree very stocky in growth, hardy and very fruitful. Season, end of August and beginning of September. Messrs. Simon-Louis mention the vigor, early bearing, hardiness, and fruitfulness of this tree, and add that it is a variety of the common prune.

CHERRIES.

The cherry has been carefully classified by European authorities. Dr. Stoll divides them into ten groups; the Pomological Institute at Troja, in Bohemia, into nine; and Dr. Hogg, of London, into eight groups. The Geans (*guignes*) and Bigarreaus I shall not note, as they are not hardy here. The Dukes and Morellos are divided by these three authorities into the following four groups: —

I. — *Sussweichseln* (Griottes douces, or Black Dukes). Acid cherries with dark skin and untinted juice, trees and foliage large, and resembling sweet cherries, such as Belle de Chatenay, Archduke, May Duke, etc.

II. — *Glaskirschen* (Cerises transparentes, or Red Dukes). Acid cherries with clear skin, untinted flesh, and trees and foliage resembling sweet cherries, such as Reine Hortense, Belle de Choisy, Transparente d'Espagne, etc.

III. — *Weichseln* (Griottes noirs or Black Morellos). Acid cherries with dark skin and tinted juice, leaves small and

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trees spindly, like that of the acid cherry, such as Ostheim, Brüssler braune, Double natte, Griotte du nord, Vladimir (of Russia), etc.

IV. — *Amarellen* (Amarelles or Griottes claires, Red Morellos, or Kentish). Acid cherries with clear skin and untinted juices, and trees like Group III, such as Grosser Gobet, Schatten amarel, Kentish, Flemish, etc.

This grouping is very clear, and yet some varieties may be difficult to classify; *e. g.*, the Kleparovka, or Griotte de Kleparov, is classed by the Troja Pomological School as a *Süssweichsel*, or *Black Duke*, and by Dr. Hogg as a *Black Morello*. Some apply the term *Griotte* to all Dukes and Morellos, and others only to Group III, the Black Morellos. This is the group of greatest promise of value to us, and yet I shall be surprised if we do not find some of the Dukes valuable as well.

Dr. Stoll remarks that cherry-growing does not pay, often it hardly pays for the picking. This, however, is because they are often planted in soils that will produce nothing else. Yet to be profitable they should be planted in such quantity as to establish a business. Would that cherries here were so plentiful as to be hardly worth picking. I have already shown that in climates colder than our own they are the food of the peasant. Then why not here?

Doppelte von der Natte (Double Natte). Mr. Lucas says a very good Weichsel, which ripens the beginning of July. Messrs. Simon-Louis describe it as a fruit of medium size, almost round, brownish black; flesh soft, with a certain acidulated flavor, very agreeable to the taste of some people. Ripe, middle of July. A variety of Griotte.

Grosser Gobet (Kurzstielige von Montmorency, or Short-stem of Montmorency). Mr. Lucas says a very large and beautiful glass cherry. Unusually fruitful, and good for table or cooking. Dr. Stoll pictures and describes this fruit as large or very large, flattened at each end, with a deep furrow on one side, dark red, fully transparent; flesh, not firm, juicy, acid, and bitter, but, when fully ripe, milder. It ripens during the fourth or fifth week of the cherry season. As a market fruit, valuable on account of its size and its short stalk. Its cultivation is highly recommended,

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but only on favorable conditions of soil. In dry or poor soil the is quite unfruitful. Messrs. Simon-Louis speak of it as a fruit tree variable in quality and the tree not a good bearer.

Grosse Lange Lothkirsche (Doppelte Schattenmorelle). Mr. Lucas says a very large, often roundish oval, blackish red, beautiful cherry for preserving. Messrs. Simon-Louis describe this under the name of *Griotte du nord*; a rather large, roundish fruit, with long stalk; flesh, a little firm, dark purple, juicy, vinous, acidulated; ripens the end of July. Tree, very fruitful, and may be grown in any form, but its true place is as an espalier, when the fruit remains on late into autumn.

Kõnigin Hortensia (Reine Hortense). This has been long known in this country; a fruit of fine quality, but the tree not as hardy as the Griottes or Morellos.

Ostheimer Weichsel (Ostheim). Mr. Lucas says a very fine, large, dark red cherry, for table or preserving. Messrs. Simon-Louis say fruit of medium size, round, purplish black; flesh tender, very juicy, of first quality when fully ripe. Season, throughout July. Tree small and of extraordinary fruitfulness.

This Ostheim cherry I have already described at length in my report on Russian fruits, in the society's eighth report, and I may add that it and other German cherries of its type are, so far, doing very well with me at Abbotsford.

Rothe Maikirsche (Anglaise native). Mr. Lucas says a medium-sized, roundish, very good and fruitful, sweet Weichsel. According to Messrs. Simon-Louis, this is a synonym of the *May Duke*.

In conclusion let us remember that the winter temperature of Reutlingen is 11° milder than Toronto; not a Quebec climate by any means; yet, on the other hand, the orchards of Würtemberg run up the sides of the mountains into bleak exposures, where the climate is very unlike the sheltered valleys below. It is, therefore, probable that these notes have their uses for this climate as well as for those who live farther south.

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THREE POINTS IN AGRICULTURE.

BY F. F. FISK, OF WEBSTER.

For an aid in discussing agriculture, it may be divided into physical, mechanical, and financial. In the consideration of the subject, the natural order is reversed, and the last is made first, viz., the financial, and the question, Will it pay is ever first. That question is as old as commerce, and as new as the last issue of an agricultural journal, or the last meeting of farmers. It was raised when the first proposal was made to exchange one product of earth for some other product. The conditions affecting a solution of that question were then very few, and all within the cognizance of both parties.

From that time, the causes affecting the question have multiplied, until it is no longer possible to answer the question, Will it pay, for seed time and harvest are continuous, the accidents of the season cannot be anticipated. The action of transportation companies, the convulsions in the business of the world, through labor strikes and fashion, all, all combine to make the profits of agricultural labor uncertain. Yet the discussion of Will it pay, still goes on, and not without its use. Taken in a general sense, the question could never be raised, for every advancement in society, socially, morally, and intellectually, rests upon agriculture as a foundation. The question is always personal. Will it pay for the individual to engage in some particular branch of agriculture? The question must always refer to some specialty, or at most, a combination of but a few items in the list of agricultural pursuits.

Though it is utterly impossible to take into consideration all

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modifying influences, if the discussion shows the relation of the influences discussed to the particular branch in which we are interested, we go from the discussion with broader views and less of that feeling of isolation which the boundaries of our little farms have drawn around us in the busy season.

The mechanical division of agriculture is older than the question, Will it pay? Before there were products to exchange, methods of obtaining those products had to be devised. We talk of "virgin soil," and easily go back in our imagination to the time when men had but to tickle the earth to make it yield a rich harvest. We see too, through that same medium, a farmer, using as a cane the straight stick with which he has been tilling the earth, met ere he could reach his home by the agent of "The Crooked Stick Co.," and can hear the arguments as they flowed like oil from his tongue, as he proclaimed the advantages of his crooked stick over the straight.

A few days later the agent of the Double-crook, Back-action Stick puts in his appearance. From that time to this, invention has been sleepless, methods have multiplied like bubbles in a boiling caldron, and like those bubbles, many have burst ere we have had time to examine them. How to do it is as difficult to answer as Will it pay? Yet we are continually asking, and men are as ready with an answer as we with our question. The forms such discussion takes in the trials of tools are good educators, giving us practical object lessons in the mechanical arts.

The physical division of agriculture, often the last to be considered, is of the first importance. Older than the question, Will it pay, older than the question, How to procure the products of the earth; for when man was compelled to till the earth, the first question was, Where? Had there been no variation in the physical character of the earth, there would have been no choiee of localities. Had there been no difference in soil, or climate, or moisture, there would have been less to build up commerce. Without supposing any of the various causes which might have led men to study the relation of the physical character of the earth to agriculture in the earlier ages, we find the red men of New England planting their corn upon the banks of streams, because the fogs that would cover their fields in consequence of

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their proximity to water would protect their crop from frost. Later we find the white men occupying those same banks, with the same immunity from frost; and when the river banks would no longer afford room for the settlers, we find them crossing the intermediate plains and building their habitations upon the hills, or even well up on the mountain sides. Evidences of these old homesteads are still to be seen in the foundations of the buildings and the stone fences that surrounded them. They sought the hills, leaving the valleys uncleared, as the local names would show, such as "Dark Hollow," where there is nothing but the huge stumps to indicate any cause for the name; but the tall pines that once stood there might have made it comparatively dark, even in midday. Those early white inhabitants, having no west from which to obtain their bread and meat, were under the necessity of choosing for their homes such places as were fitted by nature to give them food and clothing.

On those elevations they were as secure from frost as their neighbors upon the river bank. Before the outer world was opened to them, and they were obliged to depend upon their own labor for both food and clothing, they studied well the character of soil, the climatic influence of elevation and exposure to sunlight: they sought for soil and location suited to the crop necessary to their comfortable existence. By that knowledge they were enabled without the aid of commerce, save in a very limited extent, to live in a manner that guaranteed progress in wealth and refinement. Since the opening of the grain fields of the West, we have been the willing subjects of accidents. The harnessed steam is no more difficult to restrain than the American people. Railroads opened a rich country, agriculturally, and men hastened to reap the harvests so easily won. The railroads emptied those stores into the laps of New England farmers, who began to feel that the necessity of climbing high hills to raise corn no longer existed. The old houses upon the mountain sides were abandoned. The adjacent fields no longer have such rich burdens of grain and flax. The luxuriant pastures were given to dry stock, and the dairy cow was there no more. The farmers of New England became subject to the caprices of transportation companies, the avarice of speculators, and the accidents of

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seasons. It was the inventive genius of men that made this possible. By making themselves familiar with natural laws, they learned to harness the steam and to send the lightning upon errands. They combined the mechanical powers in the form of tools and machinery, which gave to one man the power of many. The manufacturers of tools and machinery and their agents are expert teachers, who, without price, offer to instruct us in all the skillful combinations they have produced; and they are men who have brought to their business talents of no mean order, seeking by the aid of science the best materials, and again by the aid of science have so combined those materials as to produce machinery, light, strong, and suited to the objects for which it is intended. Heedless of those physical laws that should govern us in our pursuits, we have added the tool-makers to the list of our masters, and become subject to the worst accident of the season, viz., drouth. That we might use those tools so well adapted to agricultural purposes, we have sought those places best adapted to their use. Such lands as we found ready for the mowing machine and contemporary tools, are lands subject to drouth, and drouth is the rule in New England.

The tools for tillage, as well as harvesting, are adapted to smooth, clean soil. Upon almost every farm there is land that never suffers from drouth, for it is always too wet. Such land has been shunned because we have accepted such tools as manufacturers were pleased to give us, only adapted to the smoothest, dryest soils, instead of demanding such as we needed. The physical part of agriculture, though first in the natural order, the one that can be discussed with the most profit, has been disregarded almost entirely. Instead of seeking some place where we can use the tools offered to us, we should demand such as we need to do the work required.

It is a law, says one writer, that wheat will not do well if sowed upon a soil made loose to a considerable depth immediately before sowing, but it should be allowed to settle, and just before sowing, a light, shallow bed be provided for the seed. To meet that law, if it is a law, we need a tool to prepare that seed-bed. We want tools to remove stones and stumps from the land naturally secure from drouth, that we may avoid that most dreaded

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accident, and prepare our land for the tools necessary for tillage.

Says Prof. Bailey: "It is more necessary now to discover laws than to strive directly for better fruits and vegetables." We need to understand the laws by which water is moved through the earth, the laws governing the requirements of plants, the laws of heat and light; for we have much water in the earth, much that we can make available as plant food that flows above the earth. We are surrounded with air. We have heat, moderate and intense. We have sunlight, bright and powerful. We have those skilled in art ready to supply any demand we may make. We need to study the physical character of agriculture, and make such demands upon our tool-makers as our needs may require, for they would be able to meet any requirement, and we may avoid in a great measure one of the worst accidents of the season, — drouth, — and become master instead of servant to the tool-makers, thus removing one great obstacle in the solution of the question, Will it pay?

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DISEASES OF ANIMALS.

There has never before been so much talent employed in the investigation of diseases of men and beasts, especially those of a contagious character, as at present. The result of Pasteur's study and experiments in anticipating by vaccination and measurably preventing the consequences of hydrophobia has given encouragement to the investigators of such diseases as are communicable by the transfer of microbes from an infected to a healthy animal.

We copy a liberal portion of a report recently made by Dr. Paul Paquin, of the Missouri College of Agriculture, regarding his experience while studying contagious diseases in Europe under the patronage of the curators of the University of Missouri. It has been communicated to us by our former co-worker, Prof. J W. Sanborn, Dean of the College. It will be read by our stock-growers and the general public with deep interest.

CONTAGIOUS DISEASES.

What is a contagious disease? It is one that can be transmitted from one subject to another of the same or different species. How is it transmitted? By different means. It may be through the air which carries the virus — the contagious matter from a diseased case to a healthy one, when it may be inhaled in breathing, as in contagious pleuro-pneumonia. It may be through the water or food, in the home and field for man, in the field and stable for beasts, where for some it may be also inhaled and others ingested, as in diphtheria, glanders, Texas fever, etc. Or it may be artificially by direct inoculation, an apparently insignificant operation, which, however, transmits the mighty and

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dreadful germs of the maladies. I say germs. It is the very point which I shall attempt to elucidate first, at the risk of being accused of repeating what has been written and spoken a thousand times; for notwithstanding this fact, the assertion that germs are the cause of certain diseases still sounds like a myth to the ears of those who are strangers to the wonderful discovery.

Did you ever stop and think how it is that an almost, if not totally invisible quantity of virus from a subject having a contagious disease can cause the same to reproduce itself with the same symptoms in another? Take small-pox in man for instance. Dip the point of a needle in one of the thousand pustules that make such a fearful sight of his body. You may not see the particle of matter left on the light instrument, and yet if you thrust it slightly into the skin of a person not having been vaccinated, that person will become affected with the horrible affliction. Does not that seem most wonderful?

Take another disease — one among lower animals. Take anthrax or charbon, which, when transmitted to man, causes the deadly, malignant pustule. How does this occur? A little scratch, the least raw sore on the surface of the skin may allow a minute portion of virus of infected hides or residues to be absorbed, and the disease takes its course. Such cases frequently occur to tanners in countries where this affection exists. It is asserted that even flies transfer the deadly poison of the malady.

Let us consider still another one — chicken cholera — the true chicken cholera which depopulates our barn-yards with such formidable rapidity. It suffices to dip a pin in the blood of a deceased bird and prick a healthy one to see it die shortly with the same affection. Then if you repeat the operation with the blood of this last bird on another healthy one, you obtain the same results, and so on, if you continue the operation. So many inoculations, so many deaths, as a rule. The same thing may be said with as much veracity of glanders, septicæmia (blood poisoning), etc.

Now if you examine with the microscope the tissues of certain parts of some of the organs (constituting the body) of subjects affected by glanders, charbon, hog cholera, chicken cholera, septicæmia, etc., you will find them to contain certain germs by the

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millions and billions — germs which you do not find in healthy subjects. But if you inoculate the most minute particle of such tissue or matter to an inoculable healthy subject, you will find the same germs reproduce themselves: some very rapidly, others more slowly. Some say those germs are the result or effect of the disease, and not the cause. In reply, I say give an example of a living thing that grew spontaneously without father or mother. No, the spontaneous generation theory or doctrine, to which Aristotle, Virgil, Van Helmont, Redi, Buffon, Needham, and later, Mr. Pouchet, Director of Museum of Natural History of Rouen, gave the authority of their names, was annihilated by the discoveries of Pasteur. His revelations at the academy of science fell like a shell on the fragile edifice and crushed its columns into atoms.

But you may say, it is not possible that the germs are dormant in the body and that they develop themselves only when certain diseases occur, diseases which, by their alteration of the system, produce a favorable soil for their growth. Perhaps, in fact, certain kinds of germs are dormant in some organs, as they are in the ground, or as wheat in a bin. But that does not say that they have grown there spontaneously. The following proves that such and such a germ gives rise to such and such disease only. If you look for the germs of chicken cholera in a healthy bird you cannot find any, not even in a dormant state; but if you take some virus of this disease, isolate, *i. e.*, separate the germs, as is done in the laboratory, inoculate a chicken with some of them, pure, free from any other substance, you will produce the very same malady. If you look in the newly inoculated subject soon after the operation, you will find them innumerable, and yet not so numerous as later on; they have only partially invaded the soil; for, although they grow and pollute with inconceivable rapidity, they are excessively small; they did not, therefore, have quite enough time to multiply themselves sufficiently to furnish emigrants and send them to the various countries of their new world. A little later, however, you will find myriads of them in many parts of the body. In substance, the same order of things may be produced with a great number of contagious diseases known, including tuberculosis (consumption). And it can be done as

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well with pure, separate germs taken from diseased subjects and cultivated in suitable soils for years outside the animal body. This is done by certain laboratory methods — a point which we will discuss further on. What power can accomplish things of such nature? There is but one on earth; there is but one power that can extract the immeasurable from a unity; it is the inexplicable, admirable, strange mightiness of life. Its marvelous laws only can explain to our senses the reproduction of these germs — reproduction which is simply astonishing in comparison with visible ones, be they ever so small. They are living organisms, happily termed by Pasteur "the infinitely small" of a world invisible to the naked eye.

Can we believe such statements? I reply by another question, Can we deny the existence of things which we can see, touch, move, reproduce? What we term contagious disease, then, probably in all cases, is only the expression, the perceptible signs of the growth of germs in the body, and it is the alteration of the system due to that vegetation that causes sickness and death. We are naturally perplexed at the wondrously quick development and increase of those little organisms. Well, is it not comparatively the same in living things that we can see and appreciate? Look at that enormous maple tree in your lawn, and consider the slimness of the green grass carpeting the ground, shaded by its heavy foliage. Both belong to the vegetable kingdom, both are mature, both are healthy, and yet what a contrast! But it has taken years, perhaps a century, to make that majestic tree what it is, — in a few months the grass has grown and perhaps multiplied itself. Sow seeds of different vegetables side by side, and you will realize the striking difference in vegetation.

The same things may be said of animals. Small ones generate their like much quicker than larger ones. The potato bug (*doryphora*), to illustrate a common one, may give rise to three generations a year, each female laying an average of six hundred eggs, which hatch in less than a week. Now think of the difference in generation with the horse. Both belong to the animal kingdom. Well, the same law seems to exercise its power over the smallest living subjects of the world; those that we cannot detect without powerful optics and means to stain them and show their confor-

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mation and size. These little ones are usually called *micro-organisms*, or microbes (derived from the Greek *mikros*, little, and *bios*, living), where we speak of them in a general manner; but when they are referred to as causation of disease, they are often termed bacteria, or germs, the title I have given them here. In some of them, seeds or eggs have been discovered. For instance, in anthrax fever, the bacteria that causes it shows brilliant spores or seeds that detach themselves, and may be preserved years in a dormant state and then grow in the animal body if they get access to it, just as oats may be kept a long time and afterwards sown with good results. They probably belong to the vegetable kingdom. Experiments point almost conclusively toward the confirmation of this belief. In fact, it is certain that some do. Like plants, too, they grow quicker, larger, and healthier in soils richer and better suited to their formation. In contagious diseases the body is the land in which pernicious microbes are sown, and among the various organs of the general system some prove better soil for some kinds of germs than others, just as certain patches of ground on a farm are better suited for some kinds of grains than others. It is thus that we find tuberculosis (consumption), glanders, contagious pleuro-pneumonia, developed principally in the respiratory organs, Texas fever in the spleen, smallpox in the skin, hydrophobia (rabies) in the bulb and spinal cord.

I have alluded to the cultivation of disease germs outside the animal body. I will explain this point more fully, and hope to convince the most skeptical.

Mr. Pasteur in his researches discovered that one could prepare as good and even better soils in the laboratory, for the cultivation of microbes than are found in the animal system. Among the many suitable ones we have chicken broth, veal and beef gelatinized broths, blood serum, potatoes, milk, etc., etc. These media just take the place of the body. In them we sow the germs pure, separated from all other matter, and they grow like they would in the system of the animal. We can reap one crop and sow an invisible particle of it in another artificial medium, and it will grow there also. We may thus get crop after crop to a thousand and more generations, and still they will preserve

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their powers of reproduction. Then, if we take a microscopic particle of the last generation and inoculate it to animals naturally apt to contract the affection which furnished the first germs for these cultures, they *will get it* and probably die from it. This question has been proved beyond refutation. I would not hesitate to repeat the experiment if it were necessary to sustain my assertions. Science has brought the cultivation of microscopic living things to a practical business. We can see them grow like a plant in a flower-pot.

Do you wish to test the subject of cultivation of germs and contagion yourself? Here is a way if you are adapted to the business of making experiments. We know that vinegar is due to the vegetation of a microscopic plant named *mycoderma aceti*. It is a minute vegetable cell which is so amazingly prolific that in a few hours it covers like a velvety scum the surface of any liquid, becoming vinegar. To obtain this germ it suffices us to take a little claret wine and expose it to the air at a warm temperature. Soon we see on its surface some little specks, and later larger ones like a film. Now take a tub, say about three feet of surface, put a liquid into it proper to the nourishment of this microbe ; water with some alcohol, a little vinegar and phosphated alkaline salts will do ; put an imperceptible particle of such specks or scum and touch the surface of this mixture. In twenty-four hours or about, the whole surface will be covered by a uniform thin veil formed by an infinite multitude of vegetable cells. One cannot appreciate them separately without a microscope. Experimentalists of repute have assured us that every thousandth square part of the surface of such a liquid sometimes contains as many as three hundred thousand cells, making three hundred millions for the whole surface. How prodigious is that strength of life ! Now if you have another basin of such a liquid, and a particle of that scum falls or is purposely deposited upon it, the same growth will take place. The operation may be repeated with the same result infinitely. These are a kind of culture. That is exactly what occurs in contagious diseases. What we can see so plainly in the tub is the phenomenon which produces itself in the body of animals. In the tub during the generation, the growth of the germs causes a chemical change to take place, and thus produces

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vinegar; in the body they produce certain poisoning principles, —*ptomaines*, etc., which, with the mechanical action of the germs, cause disorders, illness, and death.

But if like ordinary plants the microbes grow in proper soils, like them also they stop growing when the substance proper for their formation is exhausted. In fact, if we cultivate the germs of a disease in a certain and the same soil, a broth for instance, they will grow for a time and then stop, for they find no longer the elements necessary for their nourishment. Yet they may still live for a certain length of time. Splenic-fever germs, for instance, stop growing when they have exhausted the material proper for their formation, but they are not dead; they indeed give seeds, as I have said before. These seeds or spores are visible with the microscope; like those of plants to which I have compared the micro-organisms so often, they may live in a dormant state for years, perhaps, and then grow if they find a suitable medium. Such is the case when charbon develops itself suddenly in a pasture in a community where the disease does not exist. The germs may have been deposited there years before; a carcass may have been buried there, and the germs brought to the surface of the ground by earth worms. Pasteur gave us irrefutable examples of that sort. The germs of Texas fever seem to be deposited that way over certain lands.

When the soil of media sown with germs of a certain affection is exhausted, they become weaker and weaker, and when inoculated to animals in that weakened state they do not give as severe a disease as before. Fewer animals die from the effects. The germs having degenerated transmit their weakened condition or constitution to their offspring; these grow with less rapidity and are less prolific it seems, for they cause a much milder form of disease; such is the case in splenic fever, chicken cholera, etc. There is another opinion regarding the direct cause of a milder affection in similar circumstances, but this seems to be the prevailing one; for although this heredity question is incomprehensible in its principle, its operations and results are conceivable because we have examples of them in the visible world. I remember well a fine large apple tree in the great orchard that surrounded the house of my father. It was the boys and girls' favorite when

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I was a child because it bore large, red, sweet juicy apples that ripened early — and besides it was forbidden fruit. The tree at the time was getting old, however, and every year we noticed with great sorrow that it was gradually losing its vigor and that its fruits declined in size and number. They tried hard to preserve our good old friend in strength, but they knew not how. It was not dying fast; it was slowly getting weaker and weaker. This degeneration kept going on until the apples ripened before they had attained the size of a hen's egg, whilst they used to grow as large as a good-sized cup.

One day seeds from those fruits were sown in the garden, and soon little trees appeared. Two or three years later they were transplanted into the large orchard, in the best soil. There we watched and waited anxiously for the first apple. We expected, of course, the large, rosy-cheeked one of the big tree of our younger days — the tree which still existed, however, at this time, but bore shriveled fruits smaller and smaller. Indeed, I fear we were ungrateful enough to scoff at the dignified octogenarian when we beheld with admiration the first blossoms adorning the head of its young offspring. They surely would be "the goodliest trees laden with fairy fruits." How large and nice and juicy those fruits would be! The very thought brought water to many mouths. At last they showed their little faces; although we thought them rather slow in growing and then in ripening, we did not care so very much. We simply let them alone for a time, and then, behold! a little bit of an apple, not much larger than a butternut. We called it a clear case of swindling on the part of *Dame Nature*, but she had but obeyed certain laws of heredity in life. It was a transmission of degeneration from parent to offspring in the vegetable world. It is about what occurs in the weakened microscopic degenerated germs which we sow purposely in an artificial preparation, or in the animal body. Their proliferation is much diminished, and, hence, as we can readily understand, the effects of their vegetation are much milder. Struck by this phenomenon and knowing that certain contagious maladies occur but once in a long time in the same subject, Mr. Pasteur endeavored, intentionally, to weaken still more their virulent germs. And behold the beautiful result! He succeeded in

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attenuating them to such a point that they still cause a slight derangement of the system, but not severe enough to kill, and yet sufficiently powerful to confer immunity, like vaccine against small-pox in man. In other words, he weakened, artificially, the *deadly virus*, and made of it a benign one — a *vaccine*. Now, how does this vaccine confer what is called immunity; or, in other words, render a subject proof against a subsequent attack of the malady it is intended to prevent? Is it also due to exhaustion (for a time) of certain materials of the body which are essential to the rapid and numerous development of germs? Or, does any chemical change, unfavorable to the life of these microbes, take place in the system? The former hypothesis seems accepted by many, yet neither of them is a satisfactory explanation to the mind. It is a very important point to enlighten. The most important one, however, is the result obtained by introduction of weakened virus into the body of healthy animals — protection from contagious plagues. This brings us to vaccination.

VACCINATION (INOCULATION).

All forms of preventive vaccination are explained by the discoveries of Pasteur. Even vaccination for small-pox, although discovered long ago by the immortal Jenner, is explained by Pasteur's theories; indeed, scientists have established definitely that vaccine against this dreadful affliction is the virus of *horse-pox* attenuated by its passage through the bovine species (calves).

As to the substances used as vaccine for other affections, I need not repeat here their general mode of production. This has already been explained in the foregoing chapters, where we alluded to the attenuation of virus by certain methods of culture, and in this condition their introduction into the body to protect against contagion. Other details necessary will be developed as we proceed.

The matter used for inoculation, as preventives, is not always weakened virus. Indeed, there are certain very serious maladies whose virus it has been, so far, impossible to mitigate with any good result. And yet we inoculate with the same virus with good success against the very disease they cause. Such is the case in contagious pneumonia and sheep-pox. We will see further how

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in such instances the supposed immunity is conferred. By the way, it may be well to remark here that I have used the words vaccination and inoculation indiscriminately for the operation which consists in the transmission of the agent of contagion from a subject to another, but as a rule — although it has, perhaps, no great practical value — *inoculation* is meant for the artificial transmission of *non-attenuated virus*, while vaccination means the introduction into the body of *attenuated virus*, or vaccine. The affections against which attenuated virus is used as preventive are: Small-pox, hydrophobia (rabies), chicken cholera, hog cholera, blackleg, essential charbon, or anthrax (a splenic fever resembling somewhat Texas fever). So far, those inoculations, except small-pox, have been resorted to, I think, only in France, Germany, and Switzerland.

The actual transformation of virus into vaccine is arrived at on the principles already described, but by various manipulations; for some it is by means of culture with the aid of proper instruments in the laboratory, and for others it is by transmitting the disease to animals of different nature, which prove poor soil, thereby mitigating the virulent agent. The vaccine of hog cholera, for instance, is obtained by transmitting the affection to rabbits, and for small-pox it is nothing else than horse-pox attenuated through the system of cattle, as I have said. We may use vaccine directly from the horse, but it is much more powerful than after having passed through cattle. Whenever horse-pox breaks out in France now, they simply inoculate calves, and keep inoculating them for the production of vaccine for the public. So they do in other places in Europe.

Let us consider briefly the diseases which concern us more directly.

HOG CHOLERA.

I need not describe here the symptoms of this affection. In Europe it is assumed by scientists that the hog cholera of America is the same as what is termed *Rouget du Porc* in France, but American writers who have studied the matter on this continent believe they differ. Both opinions are entitled to respect and worthy of consideration. Perhaps more than one kind exists. This is a point, therefore, that needs elucidation. I would not

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venture a personal opinion on the subject, because before going to Europe I had not had the advantage of studying microscopically the American hog cholera, and I have just arrived home and have no laboratory sufficiently equipped for such a study now. Whether they are exactly the same or not, one thing is certain, we know that both are due to germs; that they resemble each other physically and pathologically, — at least to the naked eye, — and that the one in Europe is prevented by vaccination. The great object to attain is the production of an efficacious vaccine in this country. The chief of the Bureau of Animal Industry, Dr. Salmon, has and is still devoting much time and making careful researches in that direction. I had the pleasure to read, not long ago, that he had made some very important discoveries which were calculated to give us the desired results. We must assist him in his labors if we can, and this without producing confusion. Conscientious, disinterested, scientific researches may benefit his work and the country, but talk and criticisms not based on such a foundation are apt to make the matter only more difficult and obscure. If differences of opinion exist in the minds of the competent workers, it might be better to let them follow their own path towards a common end. Nothing more reasonable, nothing more rational than to expect to attenuate a virus of our hog plague on the same principle that it is done with the French hog plague, and get as effective a preventive. Unfortunately, outside of the Bureau of Animal Industry I know of no institution where such pursuits can be followed.

I have now before my eyes a report of a French veterinarian's vaccination against hog cholera (Rouget) in Lorraine. He vaccinated two hundred and eighty-three hogs with Pasteur's vaccine. Three of them only died of the disease after vaccination. At the side, or with those hogs, he had left seventy-three non-vaccinated ones to testify as to the efficacy of the treatment. The result was that the whole seventy-three died, and the two hundred and eighty others remained healthy. Is not that a beautiful success? Still this vaccine is not as true and as safe a preventive, as yet, as vaccine of small-pox is in man. Certain breeds of animals resist the vaccine of the disease better than others, and vaccination is much more successful in young sub-

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jects. Those are difficulties which even in Europe must be overcome by constant and intelligent experiments. They are the barriers which may interfere longer than any other, perhaps, with the general success of the prophylaxis. The production of an attenuated virus, even though we may have to invent an entirely new one, may not, perhaps, present greater difficulties to conquer. It is to clear all those obstructions that help is needed, — funds for animals, buildings, laboratory, instruments, etc. But do not exact such a result in a year or so. The country may possibly be rewarded for its labors within that time, but it can hardly be expected, for it takes all of that to conduct certain experiments to any practical result. What is a year of labor for such a mighty task? Give us proper time.

It has taken a great many years for Pasteur to accomplish what he has in contagious diseases. But he has done the hardest part of the work, and we have but to follow in his track. Are we then going to remain indifferent when we lose millions of dollars annually through a single disease, saying nothing of several others which, we may confidently hope, will be prevented in the future by the same methods? I hope not. To you who are personally interested in the subject, I earnestly appeal to your sense of personal benefit and feeling of generosity. Help us, and we promise our energy and life to your service.

TEXAS FEVER.

It is useless to describe this well-known fatal malady. It seems to be, to a certain extent, of the nature of the essential anthrax, or charbon, in Europe. The kind of organs principally affected, their appearance, and the germ origin, suggest that idea. The two diseases act differently, however, in their mode of transmission. It is another affection against which diligent studies may lead to the discovery of a preventive in the future. Charbon in France is vaccinated against very successfully.

BLACKLEG (SYMPTOMATIC ANTHRAX).

This disease, so common in this country, can be successfully prevented now by Cornevin & Thomas's method of vaccination, founded on the principles of microbes as a cause of the disease.

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But this method, which consists in inoculating the vaccine directly into the blood-vessels, is not, as yet, practical enough to be adopted in a general way. It may be considered in its infancy, and, no doubt, will soon be improved. The important point to observe is, that this vaccination produces immunity against blackleg, and that hence we may expect a practical process of operation ere long, even in America, if our blackleg should prove the same as that of Europe.

CONTAGIOUS PLEURO-PNEUMONIA.

I have already been severely criticised for advising inoculation against this affection in this country. Dr. Salmon, the hard-working and scientific head of the Bureau of Animal Industry, is of the opinion that it should not be practiced in such a great stock-raising country as America. The chief of the bureau has had much experience with the disease in question in this country. This fact, combined with his official position, places him in a condition in which he can judge very accurately, from every point of view, what would be the result of this treatment among stock on this continent. However, I uphold, on a scientific basis, that inoculation for contagious pleuro-pneumonia is rational, and could be practiced, *in certain conditions*, with as much success here as in France, where it is enforced by law, and effectively applied, notwithstanding what may be said to the contrary. I have seen its effects.

Perhaps I will be again personally attacked for this declaration, and, perhaps, also, my utterances may again be alluded to as based on enthusiasm. Well, just as the soldier on the battlefield must do his duty and face the fire, unmindful of the bullets of his enemies, so must we on the field of science boldly assert what we believe to be truth, and never falter in fear of being wounded. I have studied my subject and reflected on the bearing of my principles, and believing them right, nothing shall prevent me from defending them as I am called upon to do, until convinced I am wrong by logical discussion and facts, and not merely because a voice or many voices would bitterly criticize in a forbidding, authoritative tone. I respect and love authority in its principle, but duty and justice above all. Would I dare preach

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a doctrine injurious to the country? Far from my heart such a sentiment. I seek for benefits through truth, which alone can stand, and we can find truth on scientific problems only by peaceful, unprejudiced, impartial, impersonal, and fearless discussions, based on experimental observations and studies.

I think, however, that Dr. Salmon, in his report for 1885, does not really dispute the efficacy of the treatment when performed strictly in accordance with the most recent discoveries of science. Some of his publications or criticisms since are what may lead us to such a belief. But, undoubtedly, he had some good reasons for his utterances. What are the results of inoculation against pleuro-pneumonia? A very small percentage have traumatic gangrene of the tail, sometimes passing to septicæmia (blood poisoning), and then death. Statistics place the number of such cases, without death, in France in the last ten years, at two or three, and it is believed that some of these are not cases of gangrene of a septic nature, but are simply due to the inflammation which sometimes arises to a considerable extent at the point of inoculation, although no septic germs are inoculated. This may be true or may not, but in neither case, however, does it constitute a bad card against vaccination, because it is hardly more serious than accidents which can be expected in many other surgical operations of such nature, and which we do not hesitate to practice. And, besides, most of those cases of gangrene, whether septic or not, may be remedied, if attended to properly before general disorder or blood poisoning has begun. It suffices to cut the tail off, or, if it is early enough, in septic gangrene, good results may be obtained by scarifying the tail all around and above the swollen portion, and rub in tincture of iodine two or three times a day. It will be absorbed and will limit the progress of the disease, probably by killing the germs. Of course, such troubles and their consequences are a financial loss. Undoubtedly a sick animal loses some of its value during illness, particularly if the result be the loss of the tail or a portion of it. But it is better to have a cow without a tail, than to have the tail without the cow. Indeed, this ornament and the hide are, perhaps, about all that may be reasonably expected from cattle in a diseased herd, or exposed to one affected with contagious

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pleuro-pneumonia. Hence, with such a light percentage of accidents as I have stated, and the treatments which may be instituted to combat them, does it not seem reasonable to inoculate? But some countries give us a much higher percentage of accidents and death by septicæmia than that. Why is it? How is it that we have septic engorgements or swellings of the inoculated part? It is due to the introduction of septic germs into the wound made in inoculating, or in the unprotected and, perhaps, sometimes abraded and inflamed tissues after the operation. We can find those germs there, and find also the septic poison they engender in their growth. Where do these micro-organisms come from? Either from the vaccine inoculated, or from the surrounding air. Let none of those innumerable, infectious, microscopic, living things penetrate into the tissues, and there will be no kind of true septicæmia. The most favorable soil for the development and multiplication of those polluting microbes is what is called the conjunctive tissue, a loose substance which exists in abundance under the skin.

Now, could we prevent the occurrence of such accidents? Perhaps we could not always do so in the extremely rare cases of gangrene due to the stopping of circulation, caused by the work of inflammation; but in ninety-nine cases of one hundred we could, it seems, prevent septic poisoning from occurring, or limit its progress by the means already described. To arrive at that, we must first inoculate matter containing none of the infectious microbes; second, we must place the vaccinated beasts in such a condition that none ever get access to the tissues involved by the treatment. But are not the lungs from which we generally take the virus to inoculate with full of germs breathed in with the air? Is not the atmosphere more or less full of them everywhere? True; and here is the great point. Here lies one of the secrets of the disappointments which have so often served as a basis of the false opinions expressed regarding vaccination for the malady in question. If your humble correspondent and servant dared to give an advice, he would say: Choose a beast affected with contagious pleuro-pneumonia in the *first stages*, take the virus from the *pleural cavity* and inoculate immediately those to be protected, the

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whole operation to be performed with thoroughly disinfected instruments. The pleural sac being closed to the external atmosphere, it is rational to hold that its liquid cannot contain any external germs during life and immediately after death. If no other subject could be had to take the virus from than one dead since a certain time, it would be better, I think, not to vaccinate at all, unless it be urgent to protect part of a herd supposed to be already infected, and that the vaccine be gathered only a few hours after death. Then I should insist still more on taking the virus in the pleura and using strictly antiseptic methods. Carrying vaccine virus from one place to another should be avoided as much as possible. But if it must be done, let it be in proper glass tubes, having been sterilized, *i. e.*, disinfected by a high temperature, say one hundred and fifty degrees centigrade, using every precaution possible in handling. None but careful professional men could accomplish these recommendations strictly.

Some reliable operators, however, use with success the light colored liquid which exudates from little cavities formed in portions of diseased lungs in the first stages. It is certainly effective, but it is difficult to know whether it is pure or not. Owing to the fact that conjunctive tissue is a very favorable soil for septic germs, it is preferable to vaccinate superficially in the tissue of the skin — the derma; endeavoring at the same time to avoid bleeding as much as possible, for with the blood the virus may go off and no absorption take place. The point for inoculation is about the tip of the tail on the lower surface, after it has been washed thoroughly with a solution of corrosive sublimate or carbolic acid, and then wiped entirely dry with a clean cloth. Immediately after the insertion of the vaccine in the derma (some say under the skin, which would not be more dangerous if the vaccine be pure), I think it would be a good plan to cover the puncture or scarification with a little collodion and castor-oil. This forms a thick scum which would protect from foreign germs. Either a syringe or lancet is used to perforate or incise the skin. If the former instrument be used, it should be thoroughly disinfected with a solution of corrosive sublimate, or sulphuric acid, and then washed in clean water; if the latter be used, it may be sterilized by passing it in the blaze of an alcohol lamp. All this

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can be done quickly and accurately by a skillful operator and an intelligent assistant, much more so than I could possibly describe it in the shortest intelligible terms.

Is there anything like such precaution taken by the average operator? Some, indeed, are very strict, but far too many inoculate without any antiseptic methods whatever, using virus from any portion of the lungs, even long after death, and then insert that virus into the tissues without any discrimination; hence they often sow in their most favorable soils the septic germs of blood poisoning. Is it a wonder, then, that such accidents occur? Dr. Salmon is right in discouraging inoculation in this country, if he bases himself on the belief that the imperfect manner in which it is practiced cannot be remedied soon enough to render it safe and practical. It is this reason which has induced certain countries to reject it, whilst others, more advanced in science and better supplied with scientific operators, have made it a law.

Another point urged against vaccination is that subjects may become affected with pleuro-pneumonia afterward and die; or that, on the other hand, inoculation may cause the disease itself and spread it. Now, as to the first objection, we might as well put it in the way of vaccination against small-pox in man, for he also occasionally gets small-pox after having been vaccinated. The majority of such occurrences, I venture to say, are due to avoidable errors — bleeding, weak virus, etc., and certain other circumstances which defeat both objections. Let us explain them. Contagious pleuro-pneumonia is a most insidious disease. This fact is settled and well known. Hence, when inoculation is practiced among *apparently healthy* animals in an infected *herd*, it frequently occurs that subjects *already diseased* to a serious extent, and not having any perceptible signs, undergo the treatment. These are the cases which may get sick after inoculation and whose death, if it occurs, we wrongly attribute to either the inefficacy or the very effect of that operation. Indeed, there is nothing more consequent than such a result in a similar circumstance. If a cow already has *serious* lesions of pleuro-pneumonia progressing in the respiratory organs, we need not expect to cure her by starting the disease, however mild, in the other end — in the tail. It would be in *this case* like trying to stop a big fire on one side of a building by setting a little one on the other.

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And it is just in such occurrences that subjects die, and the disease spreads after inoculation. We can readily understand that. The affection was in existence and too far advanced before the vaccinator tried to protect the animal, and it continued its course as usual, if, indeed, it was not hastened by his deed, as some authors believe it may. At this point I respectfully make a few remarks respecting the regulations of the honorable commissioner of agriculture in reference to the eradication of contagious pleuro-pneumonia according to the new act of Congress. Articles, or clauses 13 and 14 give state authorities permission to inoculate "*cattle in herds in which pleuro-pneumonia has appeared only.*" Now, in accordance with the opinions herein explained, I would scarcely attempt to perform the operation under such restrictions, for it would be at the risk of falling, with the worst effects, into the errors pointed out. In a word, I would not consent to inoculate against contagious pleuro-pneumonia without having good reasons to believe it had *not* attacked the subjects, or else I would have a thorough understanding as to the results, for the deaths which might take place afterward in such circumstances would be charged to the operation as already stated, and it would but add strength to the wrong views held in this regard. It is on such principles that I have advocated the inoculation of *non-affected* animals — cattle which had only *been exposed* — in order to limit any center of infection making its appearance in a rural community, and these are the doctrines which were so severely condemned by the Bureau of Animal Industry. But now the regulations of the department of agriculture prevent any reliable investigations to be followed on the subject of inoculation, and I presume this question must be set aside. We will applaud to the restriction, however, if we can with the aid of the new law stamp out forever the troublesome affection. I wish it earnestly. And like Dr. Salmon, I believe that there is no better means of eradicating the malady under discussion than by killing *all* the affected herds, if it *can be done.* I never had any desire to oppose such a practice or deny this truth, by any means, but that does not exclude inoculation from the highest rank among the scientific prophylactic (preventive) treatments.

Now, I may be asked, how is immunity conferred, or how are

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animals protected against contagious pleuro-pneumonia without giving the disease strongly by the inoculation of pure non-attenuated virus? Well, it is probably the result of the application of one law which I have spoken of elsewhere in this writing. Certain soils in the body are better suited to the growth of certain germs, just as the same thing is true in the culture of seeds on a farm. The virus of pleuro-pneumonia grows slowly and poorly in the tail, probably because it is a soil which does not contain the elements proper to its rapid development, and consequently it is attenuated and causes a comparatively mild trouble, which insures against a second attack. This seems to be the accepted theory among a number of scientists, but of course it cannot be relied upon as a positive fact. A curious thing exists in regard to the effect of *inoculation* of certain contagious diseases, in comparison with the effects of the same when they have *accidentally* taken hold of a subject or subjects. The disease given by inoculation is much milder than that caught accidentally one way or the other.

SMALL-POX

in man and contagious pleuro-pneumonia are types of such maladies.

The responsibility of my position as director of a vaccine and experimental laboratory is very heavy, considering the thousands of human beings who, to save themselves from a horrible disease, are forced to submit to the inoculation into their body of a substance of which they know nothing — not even its source, which is of capital importance. Indeed, this is the point which necessitates the greatest prudence and a certain knowledge of the contagious diseases which may be transmitted by vaccination — I mean the affections which are transmissible from animal to man, or *vice versa*, those transmissible from man to man only, and from animal to animal.

Since we are more enlightened on the cause of contagious diseases, it frightens one to think that in vaccinating a child, other diseases worse than small-pox might be given, — tuberculosis (consumption) for instance, the most mortal enemy of life, to say nothing of other still more loathsome constitutional affections.

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But if science has given us that dread by its light, it has, nevertheless, done a wise thing; it has, by that means, forced man to be prudent, and to search deeper into the nature of the preventive treatment adopted universally. It has led to the solution of the long-discussed subject of the origin of vaccine, and thus given us the means of producing a safer article. In fact, the knowledge that vaccine is horse-pox attenuated by its passage through the bovine system (cattle) is very useful in the cultivation of vaccine, which takes the name of cow-pox. As stated elsewhere in this paper, cow-pox vaccine and horse-pox are one and the same affection. This fact has been established by experiments of the most rigid character, and approved by the French Academy of Medicine long ago. What was supposed formerly to be natural outbreaks of cow-pox had probably their origin in horse-pox which existed simultaneously in the same localities. In fact, Jenner had recognized this, or at least he doubted such to be the case, as we can see from old writings.

Before closing I should like to say a few words in regard to the treatment of Mr. Pasteur against hydrophobia (rabies), were it only to answer in a general way the innumerable questions I am asked on the subject. But my report is already long — too long, perhaps, to begin this matter which does not interest us so closely and which would add several pages to these. I will simply say that the treatment in question is a vaccination based on the same solid rock which constitutes the foundation of vaccinations used successfully against other diseases, *i. e.*, micro-organism as the probable cause of rabies; the attenuation of the virus; its mild effects when so inoculated, and the non-recurrence of hydrophobia.

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CONCENTRATION OF THOUGHT AND ACTION.

BY GEORGE S. PHILBRICK, OF TILTON, MEMBER OF THE BOARD FROM BELKNAP COUNTY.

The farmer of to-day, like his prototype of the time of Abraham, is intensely conservative. The world, with him, moves slowly; the changing of ideas, like the changing of the seasons, is gradual and almost imperceptible. Meeting the same objects year by year, surrounded by the same scenes, living in the world of muscle instead of brain, untaught in childhood to habits of thought, untrained in manhood to close, consecutive study, to reason from premise to conclusion, and from conclusion back to premise, till the logical deduction is firmly established in his mind, and thus made to become the basis of an idea from which to work out a practical result, do you wonder the world has far outstripped him in its grand onward march of improvement? Most of the thirty-two thousand farmers of New Hampshire are to-day living in a world of their own, as isolated from and as unsympathetic with the jostling, driving, calculating world around them as the poles of a battery. Isolated because living outside of the great currents of the world's thought, wanting sympathy because failing to comprehend their relations to them.

Our fathers conquered a wilderness and made them homes in the desert. Strong of heart and of hand, with simple habits, and wants bounded by the capacity of the soil, success, aye, a competence for them was certain. The great waves of commerce and trade had not reached their doors. Their farms must supply

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their every need, and a system (if system it could be called) of mixed husbandry became a necessity. They were the people, each farm a miniature world by itself, each farmer an autocrat, whose opinion was unquestioned and whose rights none invaded. I have said their habits were simple, so their wants were few; and though their families were in the main large, there was seldom pinching want. Freedom with food, clothing, and shelter, — food coarse and plain indeed; clothing in summer from flax raised by their own hands, and in winter from the wool of sheep that grazed the hillside pasture; one pair of cowhide boots a year, the legs of which were carefully preserved after the feet were worn out, and made over into a pair of shoes for the wife or one of the girls in winter, both sexes going barefooted nine months in the year, with an occasional best gown of alpaca or linsey-woolsey and a few yards of ribbon brought from abroad, and only worn on rare, very rare occasions. Of books, aside from the Bible, Pilgrim's Progress (not by Mark Twain), and Baxter's Saints' Rest, there were absolutely none. Forty years ago I do not think there was a farmer in our town that had as many books as I could carry on my arm. I doubt very much if they all did. A daily paper, a review, a magazine, a lady's book of fashions, had never been heard of, much less bought and paid for as one of the absolute necessities of life. In those days they made money. They could not help it. The soil was full as productive as to-day, and insect pests much less numerous, while the prices received for "stuff" raised on the farm, when you take into consideration the purchasing power of gold, were fully equal to those of the present.

> "There was satisfaction then in knowing
> Their grass and bank accounts were growing."

Your grass has grown, but how about the bank account? How many farmers within the sound of my voice can show $1,000 as the product of their labor for the past ten years? Is it not true that there are more farmers who have hard work to pay their taxes and make the year come around so "the ends will meet" than there are who succeed in putting a dollar at interest or make a dollar's worth of improvements on their farms or buildings? And yet you are carrying on the same farm your father did, and

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farming just as he did. I was in a village store not long since, and the merchant, after telling me the farmer sseemed to be running behind, said the trouble with them was *they did not work.* If they would only work as hard as *he* did, they could lay up something. That man never raised a potato or milked a cow in his life, and yet, in his own mind at least, he had solved the whole problem. I have heard it remarked that Cæsar would have been considered a very good king if he never had attempted to govern.

I am no enthusiast for New England farming, but I am not one of those who believe New Hampshire should be turned out for a sheep pasture. As a farmer to the manor born, and one who has made the business a study through long years of experience, instead of saying you ought to work more, I should say you ought to *think* more. I believe the art of farming is still in its infancy, and every farmer owes it to himself and to posterity to do something to help rear it up to manhood and develop it into a giant capable of meeting and overcoming all the obstacles in its path, and taking the place which God intended it should take, side by side with the great industries of the world, equal to any and excelled by none. But how are we to accomplish this result? While we have been plodding along "in the good old way," the world has got ahead of us with its steam ships and steam railroads, with its telegraphs and telephones, speaking across a continent or under the ocean; the mighty arms of commerce reaching all lands, penetrating every nook and corner of the world, bringing to our doors the products of every clime, bringing us into competition with every toiler on the globe, often offering us the very products of our farms cheaper than we can raise them. Have you ever considered what a mighty territory is just being opened up by the Northern Pacific Railroad? One hundred states as large as New Hampshire could be carved out of it, and still have room for the great state of New York. Land of the fertility of which no man has any conception if he has never seen it. East and west you could run a plow as far as from here to New York city and never take it out only to cross the streams. North and south you could turn an unbroken furrow as far as from here to Chicago, save where you crossed the

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brooks and rivers. That vast empire is being settled with a rapidity never equaled by the settlement of any other country. If you cannot make farming pay now, what will you do in competition with the wheat and corn, cattle and sheep, horses and swine of the great Northwest, as you very soon will be. I have spoken of the simple habits and plain style of living of our forefathers. Do you think you can return to them, and thus increase your income by decreasing your expenses?

Your daughters are as bright and pretty as your neighbor's who keeps the village store; are you going to refuse to add to their natural charms the benefits of an ornamental education? They are fond of music. How about the piano? Your son is as smart and promising as any in town, and you are ambitious for him to start in life a little better than you did. Are you going to make a man of him by keeping him constantly tied down to grinding toil? The woman you love and cherish — don't you want her to dress like other women whom, in your heart, you do not think half as pretty or good or self-sacrificing as she is?

How about yourself? Are you ready to live on hominy and hasty-pudding, baked meat and beans, with fried salt pork for breakfast and dinner three hundred and sixty-five days in the year? Wouldn't you be a little loath to exchange your carriage for a thoroughbred wagon or a cart with no springs at all? Are you willing to give up your newspapers, books, magazines, etc., including the thousand and one things which go to make up your every-day life, but cost money, and your fathers never dreamed of? I know you are not; and even if you could persuade yourself to do so, you could not persuade your family. Your girls would leave home for the city. Your sons would run away, and no one would blame them; and if your wife did not leave you, she would earn a martyr's crown and soon wear it. "New times demand new measures and new men" was never truer than it is to-day. The car of progress is on the track and going at a rate of speed never before realized. We have our choice to keep pace with it or be crushed by it. There is no escaping the conclusion. The man who doubts or hesitates is lost.

Most men are great only in one direction. Indeed, the world's benefactors from Moses to Columbus, from William of Orange to

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our own Lincoln, have been men of one idea, with a single aim in life, which they have followed with tenacity of purpose and unflagging zeal.

The days of mixed husbandry as our fathers understood it and followed it are past. To succeed, you must be men of one idea, one purpose, one object, and follow that as the beacon light of your existence.

Louis Kossuth, in a speech in Boston, said "Everything is possible to him who wills it." I wish I could impress that thought upon the heart of every farmer, especially every young farmer here present. You stand beside a giant oak with an ax in your hands, and commence to cut it down. You strike blow after blow, and yet make very little impression on it. Its head is still reared to the clouds and its leaves still sing merrily in the breeze. Do you falter? Do you get discouraged? Do you for a moment doubt you ability to bring it to the earth? Not for a moment; though the trunk may be gnarled and twisted and nearly as hard as iron, you still persevere, and soon the mighty monarch lies prostrate before you.

You all remember when that man went to the Saviour, to be healed of his infirmity, what our Lord replied: "According to your faith, be it unto you." Now, whether you believe in God or do not, you cannot doubt that the rule still holds good in all the affairs in life. There is no such word as fail to the man who believes in success. That man will control circumstances whose indomitable pluck and perseverance cannot be overcome by circumstances, however dark and discouraging, and like Sheridan at Winchester, "Will bring victory from defeat itself."

Study your business and study yourself, study your circumstances and study your soil. Make up your mind deliberately and carefully, taking all things into the account, what branch of farming it is best for you to follow, and then bend all the energies of body and mind in that direction. Let it be your thought by day and your dream by night. You may be discomfited, but you cannot be defeated; you will meet with discouragements by the way, but you will never yield to them, and in the end, success, rich, grand success will crown your efforts. I know that men who make a specialty in farming have been regarded as

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cranks and fanatics, but that condition is fast being relegated to the past. The man who grasps an idea and boldly starts out to follow its lead is to-day the progressive man, doing what he can to elevate his calling, and is sure of his reward, both in his pocket and in the esteem of his fellow-men.

Before I leave this part of my subject, I wish to say a word on the importance of little things, for in them lies the secret of success, and inattention to them opens the road to failure. A millionaire on a street in Philadelphia was once asked for a penny. The rich man drew one from his purse and was about to hand it to the beggar, but instead returned it to his pocket with this remark: "I don't care anything about the penny, but I can't afford to lose the interest." The law of compensation runs through everything, and the rule of interest applies where we have never imagined. A tainted milk-can may lose a customer. Vile odors from an unventilated manure-cellar, though so faint as to be scarcely perceptible by one accustomed to work around the barn, have sent many a pound of otherwise gilt-edge butter to the soap factory.

I saw a sleigh last winter which nearly one hundred years ago was owned and daily used in winter by the then governor of New Hampshire. It had been stored in a shed during the summer which had a leaky roof, and was decayed beyond repair. Five cents' worth of time and shingles would have made the roof water-tight and preserved that interesting and valuable relic.

Cross words and hasty acts while handling your cows may seem little things, and yet they affect both the quantity and quality of milk. A merchant in a neighboring town bought a fine cow from which to make the butter for his own family. Two of his clerks boarded with him and took turns milking. The first week Ben milked the cow, and she made ten pounds of butter; the next week John milked, and only eight pounds were churned. The merchant was at a loss how to account for it, but his little boy said, "Papa, I think I can tell. When Ben milked he always patted the cow and said 'so pretty Daisy,' but John would slam the milking-stool down and say, 'get up here, you old brute.'"

A bill was before the last legislature to establish an experimental station somewhere within our borders at the expense of the state,

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and it would probably have received the sanction of the legislators had it not been known that a similar bill was before Congress to establish one in every state at the expense of the whole country. I certainly hope the bill will pass. It is a step in advance and a step in the right direction, as I believe. To the careful student of the times it means much more than a series of experiments in feeding stock, cultivating the soil, and testing agricultural machinery. It means that the importance of the farming interests, in its relation to the stability, wealth, and prosperity of the whole country, is being seen and recognized by the abler minds in every walk in life as never before. I hail it as the rising of the day-star of hope to the farmer which is to usher in the glorious sun of peace and prosperity.

Shall we as farmers stand idly by with hands thrust deep in our trousers pockets, and let men engaged in other callings do all our thinking? Shall we in this our day fail to arouse ourselves and grasp the opportunity?

Having chosen your occupation — for I hold every branch of farming should be and is a distinct occupation by itself — begin at once a series of experiments. They need not be extensive or expensive even — better they were not — but in order to be of practical value, they must be extended through several years, and every step studied in detail and noted for future reference. Never jump at conclusions or accept anything as settled till you can satisfactorily explain it. The great law of cause and effect runs through every thing, and the reason why will be found of all those who patiently seek for it. I heard a young man say he believed he was made for something better than picking rocks and shoveling manure. He had not left the paternal roof, but was seriously considering the advisability of doing so. Conversing with him, I learned they had an extensive farm pleasantly located near a manufacturing village, kept a large stock of cattle of no particular breed, planted and sowed a little of almost everything without much regard to season or soil. They had no idea how much it cost per day to keep a cow or horse, couldn't tell whether it took eight quarts of milk to make a pound of butter or eighteen; thought they might get a pound of cheese from a pail of milk, but didn't know sure; "guessed they wa'n't making much, kinder keeping along."

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No wonder that young man had got, to use his own expression, *disgusted with the whole business.*

Life on a farm conducted as that was becomes as dull and monotonous as a tread-mill, dwarfing heart and mind, and deadening all the finer instincts of one's being. And yet the owner was considered one of the best farmers in the town.

This is no fancy sketch, neither is it an isolated example. Hundreds and thousands of farms all over the state are being conducted just that way, and with just such results. The farm don't pay, the boys are dissatisfied and leave home for more congenial fields of labor. Do you blame them for it? What possible inducement is there for them to remain, mere beasts of burden. No man loves labor for itself alone. The object sought is the "recompense of reward," and the pathway over which life's race is run can be made much smoother by a little forethought. Your son's mind as well as his body needs to be engaged in the struggle. How many farmers ever stop to think of this? How many ever realize that a boy has thoughts and emotions and opinions to be guided and educated, rather than contemned and crushed.

Pardon me if I digress a little. I have seen a good deal in the papers during the past ten years about "keeping the boys on the farm," and every one of the writers has failed, in my judgment, to make the point he started out to make, from the fact that they all leave the boys entirely out of the account. You get up a Fourth of July celebration, and put that old Declaration which cost our fathers so much to make, and which you and I love so well, into some fellow's hands and tell him to read it. He begins, "We believe all men are created free and equal, and endowed by their Creator with certain inalienable rights, among which are life, liberty, and the pursuit of happiness." "Hurrah, that's the doctrine; read that again." "We believe that all men are created free and equal, and endowed by their Creator with certain inalienable rights, among which are life, liberty, and the pursuit of happiness." "Yes, yes! That's it. We don't see how any one can believe anything else."

Now if you really believe that, why do you make an exception in the case of the boy whose father happens to be a farmer? The sons of men in every other calling are left free and uninflu-

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enced to choose such occupation as their tastes or talents or fancy dictate; but the boy who happens to be born on a farm has no right to have any taste or talent or fancy for anything but farming. I say the whole idea is reprehensible and preposterous from beginning to end, and the man who indulges it ought to have been born in Russia and have died childless. If you want your boys to make the most of themselves, to honor you in your old age, and bless your memory when you are gone, let them choose their own calling, no matter at what cost or self-sacrifice to yourself for the present, and you will never regret it. You had that right years ago. Shall your sons have any less than you had? They will be ten times as apt to stay contented on the farm if they know they do so voluntarily. A man must love his occupation in order to succeed in it, else it becomes mere drudgery instead of a delight.

But to return. If these propositions which I have here laid down are true, and you see fit to adopt them, and begin in earnest to study your business as men in other callings have to study theirs, take my word for it, in a surprisingly short time the world in general, and New Hampshire farming in particular, will wear a very different aspect to you from what it does to-day. No man has ever yet reached the limit of productiveness of an acre of ground. It may never be reached, but that we can make long strides in advance of anything ever yet accomplished, no man will deny.

I know a man in Belknap county who a few years ago purchased eight acres of plain land so poor it would hardly grass over, investing in it nearly every dollar he had. On it he built a silo, I think the first one built in the county. It was made of wood, and very cheaply constructed at that. Well, that man became the laughing-stock of the whole community. They nicknamed him *Silo* in derision. But he had an idea, and no matter what people said or thought, he resolved to work it out. I went to his place two weeks ago to see and learn for myself what he had accomplished. I found him bright, cheerful, happy, and one of the most enthusiastic men I have met for a long time. From the product of his eight acres of poor land (sand his neighbors called it) he has built a good house and barn, and this

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winter has twenty-one head of grown cattle and a horse, and not a pound of hay in his barn. All are fed on ensilage, and are looking better, much better, than the cattle will average throughout the county which are fed on dry fodder. On four acres he raised sufficient ensilage corn to keep these twenty-one head of cattle five months. His neighbors have long since ceased to laugh at him, but instead are studying his methods and preparing to follow his example.

If such results can be obtained from eight acres, what, I ask you farmers whose homesteads cover hundreds of acres, are the possibilities of your farms when wisely and intelligently managed so as to make the most of them?

Sir Isaac Newton, whose research and investigations in the scientific world have so blessed mankind, said at the close of his life that the great ocean of truth lay all undiscovered before him.

In view of what has been said here and in view of what we know is being accomplished around us, what shall we say of the vast possibilities of the agricultural world?

The Athenian philosophers caught the light of the sun as it flashed from the shield of Minerva, and they looked no higher. A New Hampshire farmer, standing in the gray dawn of the twentieth century, should be content with no reflected light, but taking the most advanced thought of the ablest mind of his time for a stepping-stone, let him press toward the mark for the prize of his high calling.

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OATS.

BY JOSEPH B. WALKER, CONCORD.

"A grain which in England is usually fed to horses, but in Scotland supports the people." — *Dr. Johnson.*

1. Nativity of oats.
2. Importance of the oat crop in the United States.
3. Oat crop in New Hampshire.
4. Varieties of oats.
5. Best climate for oats.
6. Best soil for oats.
7. Chemical composition.
8. Fertilization.
9. Weight of oats and value.
10. Different methods of raising oats.
11. Accidents to oat crop.
12. Cutting and curing.
13. Profit in raising oats.
14. Oat meal.
15. Comparison of United States cereals.
16. Comparison of New Hampshire cereals.
17. Agricultural progress in New Hampshire.

I.

NATIVITY OF OATS.

Of the nativity of oats we have but an imperfect knowledge.* The Bible, while it speaks of wheat and barley, says nothing of oats. Indeed, I have found no mention of this grain previous to the Christian era. Since then it continually appears in agricultural history, and with increasing frequency as we approach modern times.

* "It was cultivated by the prehistoric inhabitants of Central Europe, and is found in the remains of the late habitations in Switzerland, but Prof. Heer states that it did not appear until the bronze age and long after the appearance of wheat and barley." — U. S. Census, Vol. Agriculture, p. 493.

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It may be considered, therefore, as a comparatively modern grain, developed very likely from the plant bearing the name of "wild oats" (*avena fatua*). I may, perhaps, be pardoned the remark that the sowing of wild oats by youthful hands has, at times, resulted in a type of manliness whose excellence ranks as high in the physical as do the finest varieties of *avena sativa* in the vegetable world. I would not, however, be understood as recommending the frequent sowing of such a crop by such hands.

We are told that that worthless Roman emperor Caligula (A. D. 12–41) fed his favorite horse, Incitatus, on gilded oats out of a golden cup. Suetonius says that "for this favorite animal, besides a marble stable, an ivory manger, purple housings, and a jeweled frontlet, he appointed a house, with a retinue of slaves and fine furniture, for the reception of such as were invited in the horse's name to sup with him. It is even said that he intended to make him consul." However valuable or cheap the horse may have been, he was, without any doubt, the superior of his master. Nevertheless, the folly of the latter has preserved for us the fact that oats were known in Roman agriculture at that remote period, but we have traced them no further.

II.

IMPORTANCE OF THE OAT CROP IN THE UNITED STATES.

Oats rank third in importance among our American cereals. The crop of 1879 was 407,859,999 bushels. They grow in almost all sections of the United States, from the southern frontier of Texas to the northern line of Oregon, and from the eastern side of Maine to the swamps of southern Florida. Indeed, their northern line of culture extends far beyond our Canadian frontier up to the great peninsula of our arctic territory of Alaska. In Europe they thrive luxuriantly in all parts of Ireland and Scotland. They are at home in Norway, Sweden, and all the northern countries of that continent. Their northern limit is conterminous with that of rye and barley, reaching up to and even within the arctic circle.

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III.

THE OAT CROP IN NEW HAMPSHIRE.

We should expect, therefore — as in fact we do — to find this cereal flourishing in this cold state of ours. If we cannot compete with Florida in the production of oranges and bananas, we can beat her and all the other Southern states in raising oats.

The oat crop, which has always been an important one in New Hampshire, is very largely a northern crop. The yield south of the Ohio River ranges from less than ten up to twenty-five bushels per acre. North of this line it varies from twenty-five up to sixty, seventy, and even ninety bushels. The amount of oats raised in 1879 north of the thirty-ninth parallel of latitude was over three hundred and sixty-three millions (363,020,399) of bushels, while south of it the crop amounted to less than forty-five millions (44,818,600). More than one half of all the oats raised in the United States grow where the July temperature is from 70° to 75°, and only about one quarter (27.7 per cent) where it is from 75° to 80°.

The seventeen Northern states — Connecticut (27.52), Maine (28.76), Massachusetts (31.23), Michigan (33.93), Minnesota (37.87), Nebraska (26.18), New Hampshire (34.51), New Jersey (27.00), New York (29.79), Ohio (31.49), Oregon (28.92), Pennsylvania (27.34), Rhode Island (28.58), Vermont (37.59), Illinois (32.24), Indiana (25.02), and Iowa (33.57) — gave in 1879 an average yield per acre of 36.79 bushels, while the seventeen Southern states — Alabama (9.36), Arkansas (13.33), California (26.85), Florida (9.76), Georgia (9.06), Kansas (18.77), Kentucky (11.35), Louisiana (8.56), Maryland (17.75), Mississippi (9.87), Missouri (21.34), North Carolina (7.67), South Carolina (10.39), Tennessee (10.08), Texas (20.56), Virginia (9.47), and West Virginia (15.04) — gave a yield of but 13.48 bushels.

In 1849	New Hampshire	raised	.	.	973,381	bushels.
In 1859	"	"	.	.	1,329,213	"
In 1869	"	"	.	.	1,146,451	"
In 1879	"	"	.	.	1,017,620	"

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or about one fourth of one per cent of the whole crop of this country.

During the year last mentioned the crop occupied 29,485 acres, and yielded a return of 34.51 bushels per acre.

THE OAT CROP IN NEW HAMPSHIRE.

The following table gives the number of acres devoted to this crop in each county, the quantity raised in each, and the product per acre: —

OATS 1879.

COUNTIES.	Acres.	Bushels.	Bushels per acre.
Belknap	1,149	33,941	29+
Carroll	1,381	35,227	25+
Cheshire	2,535	90,774	35+
Coos	5,666	228,698	40+
Grafton	9,719	360,902	37+
Hillsborough	1,772	49,441	28+
Merrimack	2,692	75,039	27+
Rockingham	1,155	26,572	23+
Strafford	520	12,546	24+
Sullivan	2,896	104,480	36+
Whole state	29,485	1,017,620	Av. 34.51

It appears by this that the largest amounts were raised in Grafton and Coos, and the smallest in Rockingham and Strafford, the two first named having produced 589,600 bushels, more than one half (57 per cent) of the entire crop of the state, the former raising thirty-seven and the latter forty bushels to the acre; while the two last named produced but 39,118 bushels, raising, respectively, the first twenty-three and the last twenty-four bushels per acre.

IV.

VARIETIES OF OATS.

There are four general kinds or classes of oats in cultivation, each of which has marked characteristics. These are very easily distinguished from one another, and are: —

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1. The Class *Avena Sativa* (Fig. 1), which embraces all those varieties in which the seed branches shoot out from the stalk on all sides and form a symmetrical and rounded top. This class is familiar to us all, and has a stalk varying in height, according to culture, soil, and climate, from one to four feet.

Fig. 1.

2. A class not common with us, *Avena orientalis* (Fig. 2), in which the seed branches shoot out from one side only of the stem

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and form a kind of mane, resembling somewhat that upon a horse's neck. Hence the name of horse-mane oats which this class sometimes bears. It is a bearded oat, and more hardy than that first mentioned. It has a seed which is long in proportion to its size, and grows readily on poor soil, flourishing where the former would not live. It is sometimes called the Tartarean oat. It makes a good food for horses, but is not a desirable kind to grind into meal.

Fig. 2.

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3. The naked oat (Fig. 3), *Avena nuda*, which bears its seeds loose in the surrounding husks. It is small, and has been considered a degeneration from the common oat. It is common in Austria, where its flour is considered important as a food for invalids.

Fig. 3.

4. The walking oat, *Avena sterilis*, whose seeds are inclosed in stiff, hairy husks, each having a long, hygrometric awn twisted often closely upon itself when dry, but which, upon absorbing moisture from dew or rain, slowly uncoils, and in that act imparts to the seed a movement over the ground and into any fissures which may chance to be open to receive it. From this characteristic it often has an animated appearance, and is perpetuated by self-planting. It is valuable only as a curiosity, and may doubtless be found in the seed stores by any one wishing to test its peculiar qualities.

Whether these four classes are distinct species, I will not undertake to say. They certainly possess marked and distinct characteristics. It is with the first that we are particularly concerned, and to this I shall largely confine what I may say upon the subject now under our consideration.

There is another division of oats into white, black, and dun, the latter being probably a hybrid from the two first. There is also another still into winter and spring oats. But it will hardly pay us to tarry to dwell upon these.

The number of different varieties under these general classifications are very numerous, particularly in oat-growing countries.

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In his report upon British agriculture, made nearly fifty years ago, the Rev. Henry Coleman states that he found no less than fifty distinct varieties in the museum of the Highland Agricultural Society. Mr. John C. Morton, in his Cyclopedia of Agriculture, presents a list of as many, with accompanying descriptions of a part of them. This is as follows, viz. : —

CULTIVATED OAT (*Avena Sativa*), WHITE SPECIES.

1. Potato.
2. Sandy.
3. Hopetown.
4. Early Angus.
5. Sheriff.
6. Barbachlan.
7. Cumberland Early.
8. Friesland or Dutch.
9. Old Poland or Tam Finlay.
10. Dyock or Davidson's.
11. Flemish.
12. Kildrummy or Halkerton.
13. Siberian Early White.
14. Strathallan Irish or Earish.
15. Late Angus.
16. Gray Angus.
17. Drummond.
18. Capar Grange or Grange of Both-
19. Blainslie. [ric.
20. Georgian.
21. Early Kent.
22. New Early Essex.
23. Blue Major.
24. Malbiehill.
25. London Dun.
26. Danish.
27. Poland.
28. Three-grained.
29. Agyleshire.
30. Cleland.
31. Lancashire Witches.
32. Tuscany Early.
33. Church's or Churrick's.
34. Hanquiside.

CULTIVATED OAT (*Avena Iativa*), BLACK, DUN, OR RED-COLORED AND PARTI-COLORED SPECIES.

35. Common or Old Black.
36. Common Dun.
37. Winter Dun.
38. Brown or Archangel.
39. Red Essex.
40. Orleans Early Brown.

CULTIVATED OAT (*Avena Orientalis*), WHITE SPECIES.

41. Common White Tartarean.
42. Early White Tartarean.

CULTIVATED OAT (*Avena Orientalis*), BLACK SPECIES.

43. Early Black Tartarean.

WILD OAT (*Avena Fatua*), OCCASIONALLY CULTIVATED FOR MAKING OAT HAY.

44. Common Wild.
45. Marked Bearded.

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Avena Brevis.

46. Short.

NAKED OAT (*Avena Nuda*), NOT CULTIVATED.

47. Common Naked. | 48. Small Naked.

Danthonia Strigosa.

49. Bristle-pointed.

Avena Sterilis, OCCASIONALLY GROWN AS A CURIOSITY.

50. Animal or Fly.

Still another division of oats is frequently made, designated as early and late oats, one little regarded by the average farmer, but not unfrequently of great importance to him. If summer droughts are common in his locality and must be avoided so far as may be, to secure a successful crop, he had better secure varieties maturing in the briefest periods, and sow them as early as practicable, thereby making sure to his crop the moisture which the spring and early summer are likely to afford. The early varieties are also best adapted to lands which cannot be worked until late and afford an abridged growing period. Such lands will often give good crops of early oats, while they would be quite unlikely to mature crops of the later varieties.

If droughts are not anticipated and the growing season is of good length, the late varieties will generally be preferable. As in the case of Indian corn, the farmer must suit his seed to the climatic character of his locality.

V.

BEST CLIMATE FOR OATS.

The fact that more than half of our oat crop should have grown in the two most northern counties of the state is a marked one, and suggests some inquiry as to the climatic preferences of oats.

The best authorities all agree that this grain delights most in a cool, moist atmosphere of pretty equable temperature. Some of the best oats of Europe are raised in Ireland and Scotland, where cool weather and much dampness prevail during the growing

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season. While England is not warm enough to mature Indian corn, most parts of it are too dry and warm to produce as good oats as are produced in Scotland. The heaviest oats and the best come from high latitudes and moist localities. Four fifths of our oats are raised where the spring and summer rainfall is from fifteen to twenty-five inches.

If to a moist climate there be added a high temperature, the rapidity of growth would doubtless be hastened, a coarser straw would be produced, and, possibly, larger and heavier seeds of high quality. Further experimentation, however, is necessary to settle this last point. Thus far the best oats, either for cattle feed or for meal, have been found in countries having a cool summer climate. Where dry and hot summers prevail, subject to droughts, the oat crop does not attain a maximum yield or quality of either seeds or straw. The latter is likely to be short and thin; the former to be few and of light weight.

VI.

BEST SOIL FOR OATS.

While oats grow upon all kinds of soil, from sand to clay, they flourish most upon moist soils well pulverized and fairly enriched. One year with another, heavy oats cannot be raised on light and dry soils. Sooner or later the crop will languish, and the yield of straw and grain will both be light.* To be sure, the farmer must use such soils as he has, and if they are but indifferently adapted to this crop, he must seek new seed pretty often from cooler ground and climate. By this means he can maintain a higher standard of weight than he will be able to do by sowing continually seed of his own raising. If one aims for maximum crops of oats of high quality, he must seek them on moist, loamy ground and under such circumstances as will secure uninterrupted growth during the whole season from sowing to harvest.

* A little experience of my own during the past season illustrates this remark. My oat crop was raised upon a piece of land some sixty rods long, whose surface lay in slight alternate hollows and ridges running square across it. The former were moist all the while the crop was growing, but the latter, catching every ray of the sun and opposing every passing breeze, were dry, and became quite so during one or two periods of sharp drought. The consequence was that while the crop as a whole measured up thirty-six bushels to the acre, the hollows gave double the amount of straw and grain given by the ridges

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If you will allow me to quote from my own experience, I will say upon this point that the highest yield of oats I have any record of having raised upon my farm was fifty-eight bushels to the acre. About the same time a neighbor of mine, on land very like my own, and not eighty rods distant, was wont to get ninety bushels with no better culture.* This fact simply shows that in the case of oats, as in that of grass, corn, and other crops, particular soils have special aptitudes for particular crops, and that it is for the farmer's interest, so far as he can, to raise his oats on such of his soils as are best adapted to their production.

VII.

CHEMICAL COMPOSITION.

The following table of the chemical compositions of oats, Indian corn, and rye shows at a glance the comparative feeding value of each of these. The calculations, which have been made water-free, are taken from the United States Census of 1880: —

GRAINS.	Ash.	Albuminoids (protein).	Fiber.	Carbohydrates (Starch, Gum, etc.)	Fat.
Oats (average of 20 analyses) .	3.29	12.76	10.07	68.31	5.57
Indian Corn (8-rowed Flint) . .	1.65	13.86	2.61	76.30	5.58
Rye (New Hampshire variety) . .	2.12	13.24	2.34	80.65	1.65
Oat Straw (water-free)	2.07	2.63	68.96	30.19	1.15
Rye Straw (water-free)	9.18	7.88	39.08	40.82	3.04
Wheat Straw (water-free) . . .	3.44	2.38	40.48	50.96	2.74
Corn Fodder (white Flint field-dried)	5.13	7.57	33.06	52.49	1.75
Ensilage (corn fodder from Mass.)	6.47	7.00	37.08.	46.48	2.95

From these figures it appears that the percentage of albuminoids in oats is 1.10 less than in corn, and .48 less than in rye.

* Mr. George M. Smith, of Stark, showed the writer of this paper a bin of oats which he raised in 1886, and which yielded one hundred and twelve bushels per acre and weighed forty pounds per bushel.

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Also that the percentage of carbohydrates is 7.99 per cent less than in corn, and 12.34 less than in rye; while the comparatively worthless fiber is almost four times as great in oats as in either of the other two.

It also appears that the percentage of albuminoids in oat straw is 5.25 per cent less than in rye straw, .25 per cent greater than in wheat straw, and 4.94 per cent less than in corn fodder. While the comparative values of these grains may agree with our experience in their use, those of their straws will generally awaken surprise.

Now, let us look a little further and see what are the comparative requirements of each of the three cereals, oats, corn, and rye. According to Mr. Joseph Harris, every thousand pounds (air-dried) of oats and of oat straw contain

	Pounds of Nitrogen.	Pounds of Potash.	Pounds Phos. Acid.
In grain	19.2	4.4	6.2
In straw	5.6	8.9	1.9
	24.8	13.3	8.1

and that a crop of fifty bushels of oats (weighing thirty-two pounds per bushel) and one and a half tons of straw per acre will require a supply of 50.50 pounds of nitrogen, 36.54 pounds of potash, and 16.74 pounds of phosphoric acid from each acre.

These, at the common prices of twenty cents a pound for nitrogen, four for potash, and eight for phosphoric acid, will amount to $12.90.

The crop, at forty-five cents a bushel for the oats and ten dollars a ton for the straw, will come to $37.50, leaving to pay for labor, etc., a balance of $24.60.

But it will be really greater than this, as the atmosphere and the soil will supply a considerable percentage of the plant food required. Theoretically, this statement is not far from correct. Practically, it is not so, as we shall be unlikely to realize the fifty bushels per acre. At thirty, however, the profit would be a fair one.

I think it will be apparent upon any careful calculation, that a good oat crop is a paying crop, but that, as in the case of every

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other, the profit will vary with the return per acre. While fifty, forty, or even thirty bushels will be profitable, twenty will hardly pay the cost of raising, as the straw and grain will be as poor in quality as the yield is in quantity. With oats as with all other grains, maximum crops are generally the most profitable.

Oats have generally been considered an exhausting crop. How they compare in this respect with corn can readily be determined by comparing the requirements of the oat crop as just mentioned with those of the corn crop.

Fifty bushels of oats and one and one half tons of straw require 50.50 pounds of nitrogen, 36.54 pounds of potash, and 16.74 pounds of phosphoric acid.

The product of an acre in corn, say sixty bushels of corn and two tons of stalks, will require 72.96 pounds of nitrogen, 50.83 pounds of potash, and 41.02 pounds of phosphoric acid, or about 40 per cent more of nitrogen, about 30 per cent more of potash, and a little over 100 per cent more of phosphoric acid.

So that a good corn crop is more exhausting than an average oat crop. We must not, however, forget that the value of the latter (oats) as figured above is $37.50 an acre, while the former (corn), at eighty cents a bushel for the grain and $6.00 a ton for the stalks, will amount to $60.00. Value for value, therefore, they are about equally exhausting of the plant food in the soil.*

VIII.

FERTILIZATION.

The fertilization of an oat crop is a matter attended with some embarrassment. Too rich a soil will give an undue weight of straw without a corresponding yield of grain. Too poor a soil can afford only a scant crop of light straw and light grain. In

* This will appear from a simple comparison of the value of the nitrogen, phosphoric acid, and potash in these two crops with the value of the crops.

Their value in 60 bushels of corn and 2 tons of stalks is					$19.92
"	50	"	oats " 2	"	straw is 13.72
Value of corn crop as stated above.....					60.00
"	oat	"	"	.....	37.50

In other words, the value of the fertilizers in the corn crop is thirty-three and one fifth per cent of the value of the crop, and the value of the same in the oat crop is thirty-six per cent. So that the value of soil exhaustion by an oat crop very little exceeds the same by a crop of corn.

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the former case the oats are liable to lodge and fail to fill well. In the latter the grain will stand upright, for the simple reason that it is not heavy enough to fall down. In neither case is the crop a satisfactory one.

The amount of manure required for a good crop of oats depends, of course, upon the condition of the soil. This may be such as to demand none at all. But this is but rarely the case.

An acre of good oats, say of one and one half tons of straw and fifty bushels of grain, contains of

Nitrogen,	50.50 pounds,	worth at	20 cents . .	$10.10
Potash,	36.54 "	"	4 " . .	1.46
Phosphoric acid,	16.74 "	"	8 " . .	1.34
				$12.90

If the ground and atmosphere are in condition to afford these in the above amounts, it is evident that no fertilization will be necessary. If, however, it requires enrichment, the amount of this will depend upon the amount of plant food the soil unaided can afford. My own experience suggests that five hundred pounds of Bradley's X. L. Phosphate or its equivalent, applied to an exhausted soil, will not suffice. Twice that amount, affording

Nitrogen	28.66 pounds.
Potash	18.50 "
Phosphoric acid	104.50 "

costing, at $35.00 a ton, $17.50, might, perhaps, be sufficient. This would afford some six or seven times as much phosphoric acid as the crop could appropriate, and about one half as much nitrogen and potash as it must have. But whether sufficient or not, this could hardly be considered an economical application. Indeed, we may strongly suspect, until further experimentation demonstrates the contrary, that highly soluble, artificial fertilizers cannot be economically applied to an oat crop, except in formulas devised for that crop. It is pretty intricate and uncertain business for us common farmers to use exact percentages, particularly upon soils the exact conditions of which we may be unable to ascertain. I find, however, by rude experimentation on good

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oat ground partially exhausted, that two cords and a half of good horse-manure, costing $15.00, besides the expense of application, will secure under fair conditions a yield of from forty to fifty bushels per acre. If others here present have arrived at better results, I hope that they will report them before the close of this meeting.

IX.

WEIGHT AND VALUE OF OATS.

Different varieties of oats are valuable in proportion to their weights, which vary greatly, all the way from twenty to fifty pounds per bushel. Some of the Scotch oats reach the latter figure. So, also, do some of those raised by Oregon farmers.

In other words, the value of the oat kernel depends upon its amount of meat, and the heavy varieties yield more of this, proportionately, than the light ones. Says a writer in the last Census Report: "The strengthening or muscle-producing power of oats depends upon the amounts of their albuminoids, and, as a whole, the proportion of the albuminoids is greater in the heavy oats than in the light ones, amounting to but seven or eight per cent in some of the lighter varieties analyzed, and rising to more than fourteen per cent in some of the others."

Therefore, as oats are sold virtually by weight, the greater the weight of a crop, the greater, of course, will be its value. The legal weight of a bushel of oats varies in the different states all the way from twenty-six pounds in Maryland to thirty-six pounds in Oregon.* It is at once apparent, therefore, that it is for the farmer's interest to raise the heaviest varieties which his soil and climate will allow. In comparing different crops, the comparison should be between different weights rather than quantities raised upon equal areas.

Whenever the producer finds his oats growing lighter, he may

*The number of pounds required by statute in some of the different states and territories to make a bushel of oats is as follows: In Maryland, 26; in Maine, New Jersey, and North Carolina, 30; in California, Connecticut, Dakota, Delaware, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New York, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, and Wisconsin, 32; in Nebraska, 34; in Montana and Utah, 35; in Oregon and Washington, 36.

It appears, therefore, that 32 pounds is the general requirement, twenty-six out of the thirty-five states above named requiring that number.

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be sure that it is time to be changing his seed for a heavier variety from a more favorable region; just as the vegetable or truck farmers on the irrigated lands in the vally of the Po introduce new seeds as fast as their products deteriorate, and thereby maintain their standard.

X.

DIFFERENT METHODS OF RAISING OATS.

During the last thirty years I have tried several of the more common methods of raising oats, to all of which experience suggests objections of more or less importance.

I. I began by including oats as the second crop in the rotation prevailing in my locality, viz., corn the first year, oats the second, and grass the following six; upon sod ground broken for the first crop, and manured with ten cords of stable-manure per acre. Two serious objections to this method were soon developed.

First, the oats, owing to an excess of fertilization, grew very rank, giving a heavy, weak straw which was sure to cripple or lodge before time of harvest. You all know what the cutting of a piece of heavy, lodged oats means — much slow, tedious labor, unsatisfactory stooks, and an amount of coarse straw of inferior quality, out of all fair proportion to the yield of grain.

Second. Seeding down to grass with this crop was found objectionable. The catch was unsatisfactory, owing partly to the shading and smothering of many of the tender grass stalks in their infancy, and partly to their entire destruction upon the spots occupied by the stooks during their period of drying. This method was therefore abandoned.

II. I next resorted to the other extreme, and sowed oats without manure upon exhausted sod land broken up the previous fall. A few years' experience demonstrated fully that a condition of soil which will not produce a good crop of grass will fail to afford a satisfactory yield of oats. This method, after a few trials, was also abandoned.

III. It had become apparent that when one has an individual on his hands who cannot live satisfactorily with any others, he had best be provided for by himself. Of late years I have cultivated oats as a special crop, and had better success.

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My oats are now raised upon sod ground broken up in the fall, and in the following spring thoroughly pulverized and manured with two and one half cords of good stable-manure per acre or its equivalent, either plowed or harrowed in according to its fineness. In either event it is thoroughly disseminated thoughout the seed bed. On my ground, this amount of manure, yielding about twenty-seven pounds of nitrogen, twenty-six of phosphoric acid, and thirteen of potash, added to the natural fertility of the soil, has sufficed. Upon this, oats are sown by a seed-sower at the rate of three and one half bushels per acre, and rolled in. They have been found to lodge far less than when cultivated as first stated, and give a fair return. My crop the past season, which encountered several short droughts, was raised upon ground consisting of dry ridges and moist intervening hollows. The latter probably gave something over forty bushels to the acre: the former, less than thirty. The piece as a whole measured up at thrashing just thirty-six bushels to the acre. This rather moderate crop was due in part to the unsuitableness of portions of the land for an oat crop. To the remark that one should not raise oats on such land, it may be said in reply that the farmer must use for his crops such land as he has.

I am aware that this method is open to criticism. My old neighbor, Mr. Richard Bradley, now dead, after a prolonged life of active experience and observation, was wont to say that he had never met but three perfectly honest men in his life, and that one of those was not quite honest. So of this last method, I would say that it is not quite satisfactory, but it is the best I have yet attained unto. Some of you, very likely, have got further on towards perfection in this work, and I hope we may hear from you in a few moments. Of this, however, I feel sure, that maximum crops of oats of the best qualities require, besides good culture, either a moist soil or a damp climate, and that they prefer both.

Early sowing — say from the last part of April to the first part of May in the central part of this state — of early varieties will secure early maturity of crop, and help towards an escape from rust. A good seed bed will promote rapid growth, and invite the rain and moisture to penetrate the soil, thereby rendering assimilable the plant food in the ground, and the maintenance of an uninterrupted growth.

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There is sometimes an advantage in sowing, instead of one, a mixture of several kinds of oats maturing at or very near the same time. This comes mostly from the dissimilar habits of different varieties. Some shoot up in single stalks at considerable distances from one another. Others produce several stalks from each seed, and cover the ground more densely. If this be in good condition, the yield of grain on a given area is generally governed a good deal by the number of stems. These, too, when standing thick, help support one another, and are better able to resist the force of wind and rain. Thick sowing, also, in a measure, shields the ground from the sun's rays and prevents rapid evaporation of the soil's moisture.

This has not been a common practice with us, but the experience of foreign farmers has been such as to commend it, and I am satisfied that we shall do well to test it by our own.

The question as to the proper quantity of seed per acre for a crop of oats has given rise to much discussion, and opinions and practices have been various, ranging all the way from the extremes of from one to eight bushels. The object sought is to fairly cover the ground with the growing crop, and a moment's reflection must convince any one that the quantity should vary with the variety sown and the condition of the ground. If it be one which sends up few stalks, more seed will be needed than if it be a kind which produces many. At the same time it is useless to over-seed land in low condition in the hope of getting a good crop by an undue number of stalks.

It is impossible, therefore, to establish any rule of universal application. The cultivator must study surrounding conditions, and adjust the quantity of seed to these as well as he can. Common sense and personal experience will generally guide a man aright. After successive trials every season for the last thirty years, I have found that most of my lands require a seeding of about three and one half bushels per acre. Your better or poorer lands than mine, as the case may be, may vary a good deal from this quantity. One may just as well attempt to fix the quantity of water to be mingled with a glass of toddy without regard to the strength of the "rotgut" or the coating of the "toper's" stomach who is to swallow it, as to settle arbitrarily upon one fixed quantity of seed for an oat crop.

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With us, oats are usually sown by hand. Machine-sowing, however, has been practiced to some extent during the last ten years, and for various reasons is the preferable way. The work is more quickly accomplished, and the quantity scattered can be more accurately gauged during the progress of it. If the usual area is not large, say not over eight or ten acres, a little hand-sower, costing five or six dollars, is all the machine required, and a man of ordinary capacity can learn its use in ten minutes. If, however, the areas are extensive, and particularly if it be desirable to sow phosphates as well, a larger machine operated by horse-power becomes necessary.

XI.

ACCIDENTS TO THE OAT CROP.

There are three serious accidents to which the oat crop is peculiarly liable, viz., drought, rust, and lodging. Fortunately, however, it is rarely subjected to all three of these in a single season. If it be pinched with drought, it will not fall down, and rust seldom deems it an object to strike a light crop. But whether these come singly or by twos or threes, their presence is objectionable, and should be avoided if possible.

1. *Drought.* — The best remedy I know of for drought is early sowing, a favorable soil, a deep seed bed of fine tilth, manured as highly as the crop will bear, and no higher. These conditions will secure all the moisture the rains, dews, and fogs afford. The crop will be well advanced early in the season so as to shield the ground and prevent rapid evaporation, while its early maturity will abridge the period of its exposure to the dry spells to which the summer may be subjected.

2. *Rust.* — I do not know that we can do very much to prevent rust. The use of the very best and most healthy seed may aid somewhat in this direction. In fact, anything favoring a vigorous and rapid growth is a protection. In the vegetable as in the human family, the individuals of most abundant vitality and strength stand all exposures best. Early maturing oats are, as a general thing, most likely to escape this pest of the oat field, and such varieties should be carefully selected.

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3. *Lodging.* — The means just suggested will be found in some degree efficient for the prevention of the lodging of an oat crop. The pretty frequent change of seed with a view to raising the greatest weight of grain upon the least amount of straw may also aid somewhat in the effort to keep the straw upright until it is ready to cut. So, also, will particular care as to the sufficient and least sufficient fertilization of the field. Too heavy manuring, resulting in heavy straw, will be quite sure, by the aid of some shower attended by wind, to lay the crop as flat as the lily-pads of a muck-pond, thereby preventing the full development of the heads and seriously diminishing the promised yield.* If one would secure a maximum crop of oats he must give himself to a meeting of the requirements of that one crop, and not treat it as part of a rotation, or sacrifice its particular wants to those of others coming before or after it.

XII.

CUTTING AND CURING.

The methods of curing oats will vary with the character of the ground and crop. If the area be large, tolerably level, and smooth, an oat crop may be most economically cut by a horse-power reaper and binder. If the reverse is the case, we must depend upon the sickle, the cradle, or the scythe. The high price of labor has rendered obsolete the first of these. The difficulty of finding men knowing how to use it is displacing the second, and in many sections the mowing of this crop has already become the general practice. This requires no skilled labor, and the crop may be removed from the field in a short time after it is cut — an important consideration if the land is to be seeded to grass the same season. The straw, of course, will be left in a tangled condition, but this is an objection of little weight with persons who have their oats thrashed by a machine. In that event all straw is left in uniform condition after thrashing, whatever this may have been before it was cut.

The time of cutting will vary, of course, according to the pur-

* It is the practice of some farmers to sow a small quantity of rye with their oats. The stiffer stalks of the former are supposed to give additional support to those of the latter, while a slight admixture of the smaller cereal rather increases than diminishes the value of the crop.

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pose for which the crop has been raised. If designed for forage simply, it should be cut while in the milk, and dried like hay before it is housed. If grain be the main object sought, it should stand until the straw is nearly dry, particularly if it is to be housed soon after cutting. If it is to be bound in sheaves and stooked, it may be cut while the piece is partially green, as the grain and straw will both ripen in the shock. The scattering of loose seeds over the ground, incident to the mowing process, will also be largely avoided by early harvesting.

I have generally found that when land is sown to grass immediately after the removal of a mowed oat crop, a new growth springs up and covers the tender grass plants. This, if thick, had best be removed before the frost prostrates it, lest it smother them.

The binding and stooking of oats can be neatly and well done, or done very poorly. If the sheaves be large and the stooks built solid, the oats will dry imperfectly and slowly. In this case, if the ground has been previously sown down to grass, this will be killed upon the spots occupied by the stooks. The sheaves, therefore, should be small, neatly bound, and so arranged as to allow a free circulation of air around them. Care in this regard will abridge the period of drying, the stooks will touch but a portion of the ground they cover, and the limited spots of grass killed or retarded in growth will be restored by or before the next season by the advances of the surrounding plants.

Stooks of various styles are common. The sheaves may be set up a short distance apart and in a circle, all sloping toward a common center, and neatly capped (Fig. 4).

Fig. 4.

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Sometimes, when the oats are nearly dry enough for the barn, and the weather seems permanently fair, the bundles may be left

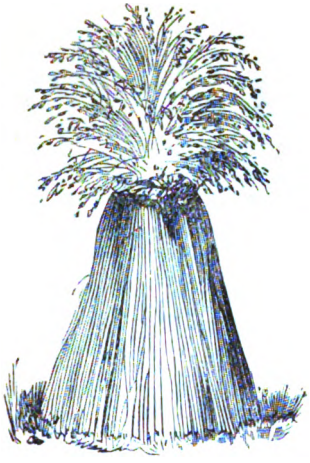

Fig. 5.

unprotected (Fig. 5), or be set up a few together without any cap, covered sometimes, perhaps, by a single sheaf laid horizontally upon the top of them (Figs. 6 and 7).

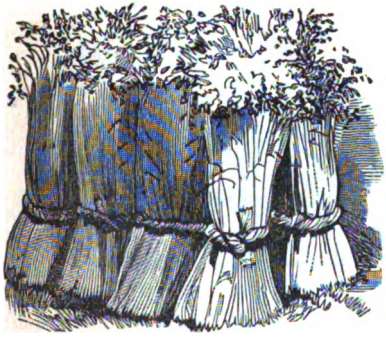

Fig. 6.

The more common way, however, and probably the better one, all things considered, is to allow four bundles standing six inches

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apart in a line to slant against four others similarly placed at an inclination of some seventy-five or eighty degrees. After placing

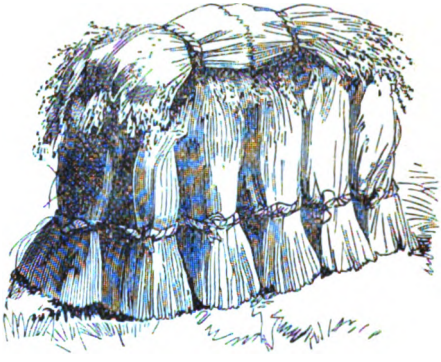

Fig. 7.

a single sheaf at each end of this collection, the whole may be covered with a neat cap formed of two inverted sheaves firmly bound together (Fig. 8). The ways of making sheaves are various,

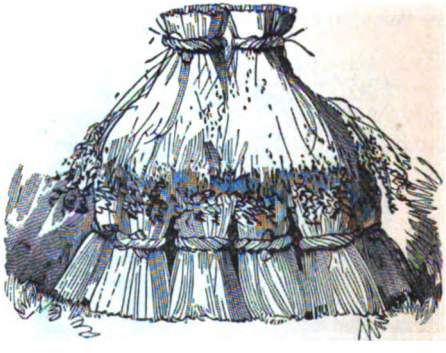

Fig. 8.

and the best are those which most perfectly secure the protection and speedy drying of the grain.

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XIII.

IS THERE ANY PROFIT IN RAISING OATS?

This question can generally be answered in the affirmative by the New Hampshire farmer. The amount of profit must depend, of course, upon the amount of his skill and energy, and upon the character of his ground and his climate. Almost anywhere in this state he can raise his oats at a less price than he can buy them.

In the central part of the state, where labor is high, the expense and return of an acre of oats on favorable ground are about as follows, viz. : —

Expense.

Breaking up one acre of sod ground .	$3.00	
2½ cords of stable-manure . . .	15.00	
Harrowing ground and applying manure	5.00	
3½ bushels of seed, sowing, and rolling .	2.40	
Cutting and housing	3.50	
Thrashing 50 bushels at 8 cts. . . .	4.00	
		$32.90

Return.

50 bushels grain at 45 cts. . . .	$22.50	
1½ tons straw at $10.00 per ton . .	15.00	
Unexpended manure left in soil unknown		
		$37.50
Profit		$4.60

If it be urged that this is a small profit, it may be said in reply that on land worth fifty dollars an acre, this is a return of nine and one fifth per cent. This surely ought to pay a satisfactory interest and all reasonable taxes. The land is as safe an investment as United States consols, and the crop pays far better. Besides, by smart farming and favorable conditions, this return may be a good deal increased, while the expense of it may be somewhat diminished.

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XIV.

OAT MEAL.

That conceited, intolerant, altogether disagreeable, learned, and glorious old fellow, Dr. Samuel Johnson, who lived in London and made the best dictionary of the English language ever made, up to his time; and who was as little partial to a Scotchman as he was to a clean shirt, defined oats as a "grain which in England is generally fed to horses, but in Scotland supports the people." "Yes," retorted the canny Scotch Lord Elibank, "and where else will you see such horses and such men?" This badinage occurred a hundred years ago, and oat meal has now become an important article of food for "the people" of England and America as well as of Scotland; and, to one who likes it, none can be more palatable, and certainly none can be more healthy.

We formerly got our oat meal from abroad, where the process of manufacture consisted —

1. Of kiln-drying the oats, that the shells of the kernels might the more readily be removed.

2. Of passing them through a mill where stones had been set sufficiently far apart to remove these shells from the meats within them by a kind of rolling process.

3. Of a sifting operation whereby the hulls and meats were separated from one another. This done, the latter were ground a second time, or not, according to the fineness of the meal desired, the coarser product being intended for porridge or "parritch," as the Scotch call it, and the finer for cakes.

But we are now making as good oat meal in the United States as is made in any part of Europe, and our processes of manufacture are not inferior to any in use abroad. Instead of restricting themselves to two, our American millers turn out at least three or four different kinds of meal, varying in fineness from the unbroken meats of the oat kernels down through successive grades to that of flour.

The three specimens I here submit to your examination (Figs. 9, 10, and 11) were found on sale at two of the Concord groceries, and more, doubtless, could have been collected had the

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effort been made. But these suffice to illustrate what I have said, and persons wishing further information upon the subject can easily procure it. The specimen marked 9 is called "Pearled Oats," and is the coarsest variety manufactured, consisting simply of the unbroken seed with the hull removed. Those marked 10 and 11 are varieties in most common use.

Fig. 9.

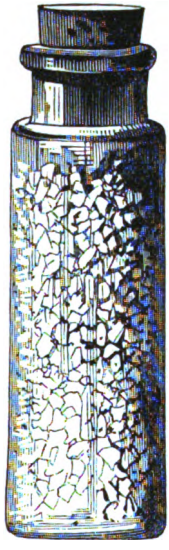

Fig. 10.

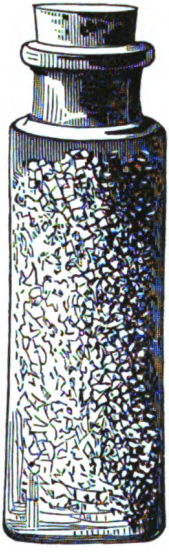

Fig. 11.

The best oats yield about one half of their weight of meal, and from the meal standpoint are the most profitable for the farmer to raise. Very likely from every other the same may also be true.

The use of oat meal as an article of human food has largely increased during the last fifteen years. Hardly a grocer in our larger towns does not find it for his interest to keep a good supply of it in variety for his customers. As in Dr. Johnson's day, oats is still "a grain in England usually fed to horses," but is no longer restricted to these outside of Scotland. And, indeed, we can but believe that were the old fellow now living, he would

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daily fill himself as full of oat-meal porridge, and with as much gusto, as he was wont to do with tea, when he had an opportunity, from Mrs. Thrale's teapot.

XV.

COMPARISON OF CEREALS IN THE UNITED STATES.

The whole number of our principal American cereals is but six, viz.: Barley, buckwheat, corn, oats, rye, and wheat. Rice is an important cereal, but its production is confined to but thirteen states. The relative importance of these, based upon acreage and production, is shown by the following table taken from the United States Census Report of 1880: —

TABLE.

GRAINS.	Acres.	Bushels.
Barley	1,997,727	43,997,495
Buckwheat	848,389	11,817,327
Corn	62,368,504	1,754,591,676
Oats	16,144,593	407,858,999
Rye	1,842,233	19,831,595
Wheat	35,430,333	459,483,137

It appears from this that in point of acreage Indian corn ranks first, occupying nearly twice the area of wheat, and nearly four times that of oats. If looked at from the standpoint of production, the same order prevails, the corn yield being almost four times that of wheat and more than four times that of oats.

It is difficult to realize the significance of the figures in the above table. If, however, we apply to them some large unit of measurement it may aid us in that effort. The area of the oat crop is 16,144,593 acres. Were the thousands of fields aggregating this amount gathered in one and laid down upon New England, it would cover all of New Hampshire, all of Vermont, all of Connecticut, all of Rhode Island, and lap over nearly a million (920,180) of acres on Massachusetts. A very respectable field certainly as regards size. If the four hundred and eight

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millions of bushels, equal to 497,587,978 cubic feet, which constituted the oat crop of 1879, were collected in one rectangular pile upon an area equal to that covered by the national capitol at Washington, it would rise to a height of more than three thousand feet, or six times that of the Washington monument.

XVI.

COMPARISON OF CEREALS IN NEW HAMPSHIRE.

The relative importance of oats among the cereals in New Hampshire is seen by a glance at the following: —

TABLE.

GRAINS.	Acres.	Bushels.	Value.
Barley	3,461	77,877	$ 70,089
Buckwheat	4,5	94,090	47,055
Indian Corn	36,612	1,350,248	1,147,710
Oats	29,485	1,017,620	457,929
Rye	3,212	34,638	54,513
Wheat	11,248	169,316	169,316
	88,559	2,743,789	$1,946,602

Of a total acreage of 88,559 acres devoted to cereals, 29,485, or thirty-four per cent of the whole, are given to oats. Of a total yield of 2,743,789 bushels of cereals, 1,017,620, or thirty-seven per cent, were of oats. Of a total value of $1,946,602, the sum of $457,929 attaches to the oat crop.

As regards acreage, production, and value of crop, oats in this state stands second to corn only, a fact which suggests the climatic adaptiveness of all parts of New Hampshire to the requirements of this grain. While even corn, our leading cereal, flourishes but indifferently in some sections, oats is at home in all. In the valleys and along the streams; upon the dividing ridges and table-lands; at the level of the sea and three thousand feet above it; everywhere, indeed, where useful vegetation is possible, from Indian stream to Massachusetts's line, oats are a reliable crop. And

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for it there is a constant demand, which the farmers of the state but partially meet. Hundreds and hundreds of car-loads of oats come in from abroad to supplement our own deficiencies.

That the farmers of New Hampshire can supply these, without outside aid, there can be no reason to doubt. Our present average yield is but thirty-four and a half bushels per acre. Most of the varieties cultivated are of light-weights. Our oat acreage is less than three per cent of our arable area. The bestowal of increased thought and energy upon this crop, a considerable increase of its acreage and a wise care in the selection of seed, accompanied by an enterprising purpose to double it, would easily lead to the attainment of this end.

XVII.

AGRICULTURAL PROGRESS IN NEW HAMPSHIRE.

But not only as respects the oat crop ought we, as New Hampshire farmers, to make advances, but along the line of all the cereals as well; indeed, of all the agricultural products with which we have to do; of the root crops and grass crops, of the returns of our flocks and herds and dairies.

I have never despaired of the future of our New Hampshire agriculture. I have seen the populations of many of our farming towns diminishing year after year. I have seen farm after farm given up first to pasturage and afterward to forest. I have seen the product of many, still worked, growing less year by year, yet I have ever been confident of our future.

In the development of this great nation thousands of our best and ablest men and women have been called to other states to assist in laying there the same foundations their forefathers had helped to lay here. We have missed them, and their absence has been felt severely. Still, our dear old commonwealth has yet left to her sons and daughters just as good; brains as active, eyes as keen, arms as strong, hearts as noble and heroic. To despair of our agriculture under the shadow of these fleeting clouds is to yield to a fear unworthy of our lineage, and to confess to a blindness as to what is transpiring all about us, of which we should all be ashamed. For the temporary dullness in the move-

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ments of the great interest to which we are devoted is but the pause which always precedes transition, the preparation for a new departure, the taking of breath for a rise to a higher plane of life and enterprise.

During my agricultural life I have seen the mowing-machine and reaper appear for the first time in our fields to displace the scythe and cradle; the wheel horse-rake, to substitute for tedious toil a pleasant recreation; the hoe and clumsy spike-tooth harrow, slow in their imperfect work, yield to soil-pulverizers which do better work in half the time. I have had the pleasure to welcome the advent of the tedder, the manure-spreader and the seed-sower, which have changed the tedium of coarse labor to pleasant occupation. And just now we are all rejoicing at the coming of the sulky plow, upon which the farmer rides forth alone in the morning, and, after a short day's work, returns but little fatigued, leaving behind him in his field two acres of inverted sod as the result of his nine or ten hours' work. By the aid of this one implement he has broken up twenty-five per cent more ground in a day than he formerly did, and at one third of the expense. Surely, if any one has reason to bless the inventive genius which has done so much to increase the efficiency of the machinery employed in his occupation, it is the farmer.

But we must not forget that there is a moral progress, of far more value than any of a physical nature, which directs the latter and stimulates its activity. Our New England character has doubtless been a most important power in moulding for good the successive longitudinal belts of new states which from one decade to another have come into being upon our western frontier. Yet, the strength of this has been moral mainly, based upon intelligence, correct ideas of religious liberty and restraint; clear convictions of right and wrong and of the personal obligations due from the individual to his Creator, to his neighbor, and to the state.

The strength of the state and the prosperity of its industries rest clearly upon the character of its citizens. It was their moral, and not their physical, power which enabled that little band of conscientious, liberty-loving men and women up in the valleys of the Waldensian Alps to defy for ages the assaults of the papal

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power, until a united Italy called them down to the plains to establish everywhere, from the head-waters of the Po to the Strait of Messina, the great principles which they had preserved in purity to the appointed time.

Let us remember that we are not farmers only, but citizens as well, and a part of the state. The time is fast passing and, it is to be hoped, forever, when a tyrannical ruler can boast, "The state, it is I." The time is already here when its free-born citizens can say, "We are the state!" Let us read again, and thoughtfully, the words of Sir William Jones: —

"What constitutes a state?
Not high raised battlements or labored mound,
Thick wall or moated gate;
Not cities proud with spires and turrets crowned;
Not bays and broad armed ports,
Where, laughing at the storm, rich navies ride;
Not starred and spangled courts,
Where low-browed baseness wafts perfume to pride.
No! men, high-minded men,
With powers as far above dull brutes endued,
In forest, brake, or den,
As beasts excel cold rocks and brambles rude;
Men who their duties know,
But know their rights, and knowing dare maintain."

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THE GARDEN FENCE.

In the last report of the Massachusetts Board is a paper with this title, given at the meeting at Framingham, December, 1885, by Prof. L. H. Bailey, of the Michigan Agricultural College. "It is full of meat," and very suggestive of thought. We copy it, with full credit, with the assurance that nothing more valuable can be found to fill the space it occupies.

THE GARDEN FENCE.

BY PROF. L. H. BAILEY, JR., OF THE MICHIGAN AGRICULTURAL COLLEGE.

Horticulture, the art, is old. It had its origin with twin agriculture, in the fertile valleys of Asia, while yet the world was new. Man early learned to till the soil. He was a farmer. The earth gave him her fruitage. He selected and improved it. Generation after generation the slow increment of progress accumulated. The fruits of the first garden gave place to others. Gradually the old were lost, and the best were scattered to the four quarters of the globe with the early migrations of men. The history of many of our cultivated plants is almost a history of the human race. But with the gift of fruits, God sent other friends, disguised. Weeds originated when cultivation originated. There are no weeds where there is no cultivation. They are enforcers of duty. They early punished neglect with the consuming growth of tares. They have always been coercers of improvement. It is singular that we do not recognize this fact. Even Virgil was alert to it: —

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"The father of human kind himself ordains
The husbandman should tread no path of flowers,
But waken the earth with sleepless pains.
So pricketh he these indolent hearts of ours,
Lest his realms be in hopeless torpor held.
. . . All these things he did
That man himself, by pondering, might divine
All mysteries, and in due time conceive
The varying arts whereby we have leave to live."

Surely ours is a goodly heritage. Until our time has man improved upon nature, till the first parents of cultivated plants are lost, and we are bewildered with endless variety. If we cannot discover the devious path by which every fruit has come through the centuries, gathering here and there an element of that mysterious something which better fits it for the use of man, we can, nevertheless, enjoy an heritage which surpasses the hanging wonders of Babylon or the fabled gardens of the Hesperides. Perhaps we are approaching the limits of this development. Certainly our methods of cultivating are not essentially different from those which find record in Columella or in the verse of Virgil, methods which in essence were old when those authors wrote. The ancient art appears to have taken on a fixedness which is indicative of staid old age. We plow, and sow, and reap as did our fathers. If we reap more than they, it is chiefly because we have improved a little more in the line of their improvement. Surely here is not a field for the impetuous Yankee, who would conquer countries of which his father had never heard, who is irrepressible in any enterprise which promises profit, and demands business, brass, and brains.

In 1795 a short and unpretentious article on grafting appeared in the Philosophical Transactions of England. The writer had observed that in England the most disastrous of the diseases of the apple and pear was the canker, — a browning and dying of the younger shoots. It was the common opinion among orchardists that this disease is caused by a deterioration of the variety; the older varieties were running out. The writer opposed this view, and assumed that the disease had been conveyed, in each particular instance, by unhealthy scions. He conducted a series

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of experiments. He procured healthy young stocks, and grafted upon them the brightest and thriftiest scions he could secure from the cankered trees. When these had grown, he inserted the best scions which they afforded on other fresh seedling stocks. This progressive operation was repeated for six generations. Although he did not escape the canker, he found that he had hit upon a fertile trail. He satisfied himself that scions from old and worn-out trees are prematurely productive and short-lived, and reasoning from this he concluded that scions from very young seedlings would prove to be tardily productive and long-lived. Numerous experiments appeared to prove the proposition. Scions maintain their essential characters when set upon other stocks, or at least the characters of growth and fruitfulness. The graft will probably not endure long after the natural expiration of the tree from which the scion was taken. Probably most of the ancient varieties of apples had been propagated from scions from old and feeble trees, and, as a consequence, most of these fruits known to Parkinson and Evelyn had become extinct. The direct and impartial statements, the scientific methods, and the novelty of the subjects treated, at once brought the paper and its author into prominent notice.

Four years later our author appears again. Again he is a pioneer. The canker in apple and pear trees still demands his attention. He had observed that in the animal world inbreeding produces disastrous results. May there not be something akin to this in the vegetable kingdom? He proposed to cross-fertilize one variety of apple with another, hoping from the seeds of the cross to secure new and healthy varieties. Impatient for results in a field entirely new, he began experiments with pease also. The progeny of the crosses were new and peculiar, and the details of the experiments are still full of absorbing interest. At this time the whole manner and method, the whole physiology of the phenomena of pollination and fecundation were unknown. Numerous doubts arose in the mind of the experimenter. He endeavored to ascertain if one seed could be the product of two males, if the quantity of pollen used exerted a varying influence, if the male or the female parent is the most potent, if successive crosses would still change the offspring, if the characters originating from

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crossing can be discharged by subsequent culture. He experimented with apples, pease, wheat, grapes, and other plants. We who are familiar with the magnificent science which has to do with the crossing of plants, which first took definite shape and direction under the genius of Darwin, and which in its phenomena and influence is boundless, are fully prepared to admire those men who first caught a glimpse of this wonderful plan of nature. We look with a species of reverence upon Conrad Sprengel, who in 1787 began to study in the fields the mutual relations of flowers and insects, and who became impressed with the idea that all parts of the flower subserve some definite economy; that "the wise Author of nature would not have created even a hair in vain." But in this same year, 1787, a greater man than Sprengel began his work upon the same subject. The German and the Englishman, unknown to each other, caught the thread of nature's purpose, and began to unravel her close-woven fabric. The one interrogated nature in the field, the other courted her in the garden. Our author, the Englishman, was impatient to apply to the common uses of life the discoveries he had made, although he recognized, perhaps as fully as the other, their importance to the preservation of species in wild nature. He saw, too, the relation of the insect to the flower. "Nature seems to have wished that no flower should be fertilized by its own pollen," said Sprengel, — a statement which has become celebrated. "Nature intended that a sexual intercourse should take place between neighboring plants of the same species," said our author, — a statement truer than the other. "Nature abhors perpetual self-fertilization," said Darwin. Our experimenter gives a pleasant account of the agencies of insects in cross-fertilizing plants. But after all he saw more clearly the relations of the phenomena of crossing to the much-loved plants of his garden, and ventured the assertion that "by this process it is evident that any number of new varieties may be obtained; and it is highly probable that many of these will be found better calculated to correct the defects of different soils and situations than any we have at present; for I imagine that all we now possess have in a great measure been the produce of accident; and it will rarely happen, in this or any other case, that accident has done all that art will be found able to accomplish."

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Among the flowers of his garden, our author became convinced that all the parts of the flower — the showy petals, the stamens, and the pistils — are but modified leaves. Although he was not the first to conceive these ideas, he nevertheless arrived at his conclusions independently, for the studies of Wolff and the poet Goethe were then unknown in England. Upon this apparently singular assumption rests much of the important investigation of to-day. He studied the motion of sap in trees, and made numerous experiments, some of which proved that the ascent of sap does not take place between the bark and the wood, but through the wood itself. In 1811 he gave to the world the now familiar method of root-grafting, with which he had experimented upon the pear, apple, plum, and peach. A year later he published a minute and interesting account of the movements of tendrils, a subject now made classic by the work of Darwin. About the same time he introduced a peach which he produced from an almond. In the same scientific and quiet spirit he discussed the causes which influence the direction of roots, the nature and extent of expansion and contraction in the trunks of trees occasioned by heat and cold, the parts of trees first impaired by old age, and a long line of vital subjects, always with well-directed experiments. In many cases he came near anticipating some of the beautiful generalizations which we now know as Darwinian.

But what is the significance of this work, and who is its author? Horticulture has become a science, and Thomas Andrew Knight is its founder! Science has climbed the garden fence. It is not enough that we plow and sow and reap as did out fathers. Unto us are given countries to conquer of which they had never heard. Here is work for the impetuous Yankee; work which is as boundless as time and energy. Horticulture, the art, is old; horticulture, the science, is new. To get our science from the field and the laboratory into the garden is the problem of the age. We must demand it there. Therefore, I propose to speak to you about the garden fence, or what we don't know about horticulture.

The fence which stands between theory and practice is relative. It exists and it does not exist. It depends upon the position of the observer, or rather upon his definition of the word practice.

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This word practice is much abused. To one all knowledge is practical; it is a part of a grand scheme of progression, and, sooner or later, it exerts an influence upon some one or more of the varied industries which support the life of man. This is a philanthropic view of learning. It recognizes the important fact that all knowledge is practical, because it adds to the weal of mankind. Money is not always the true measure of the practical, else what is practical to the recipient is impractical to the giver. A person looked through a scientist's microscope; he saw the peculiar objects which were explained as the parts of a fungus, but he saw no application of the knowledge he had gained. "What's it good for; what's the use of all this study?" he asked with disgust. "It gets me a living, sir," retorted the scientist. We must not measure knowledge by its immediate effects, any more than we should measure an apple tree by the young seedling. But he who invariably measures the influence of education and knowledge by money is a niggard, and is opposed to advancement. It is time we did something for the fun of it. If we are to make science conducive to the needs of man, we must search all science, for we know not where some treasure is hidden. The horticulturist will quite as often find some useful hint in an inconspicuous weed by the roadside as in the cultivated products of the garden. It was by experimenting with a frog that Galvani discovered galvanism. That frog lives in every industry which brightens our civilization. It was a wild geranium which gave Sprengel the hint of that wonderful kinship which exists between the insect and the flower; and that wild plant of the fields will always linger in the traditions of our science and our horticulture.

One can never become a successful investigator in any subject if his whole skill and education are confined to that subject. Much of our experimenting is entirely worthless, because the experimenter is not able to grasp the relations which exist between his subject and other subjects akin to it. And herein lies the greatest gulf between theory and practice. Says an experimenter, Prof. W. R. Lazenby: "Nothing that is really good or true in theory can ever fail in practice. If failure occurs, it proves that the theory is false or the practice incomplete." It is

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singular how loudly many men decry the opinions of scientists as vague and impractical theories, while they themselves are bristling with whims and notions that would do justice to the absurdities of the Middle Ages. If a thousand devils can dance on the point of a needle, how many stalks of chess will grow from one grain of wheat?

But after all, there is a conspicuous fence about the garden. The botanist searches for plants in woods and glades and fields; he studies them; he chases them to the garden fence and stops! When a raspberry gets into the garden it is without the pale of the true science of botany. "Our roses have ceased to be a botanical study," said a great botanist, when, in fact, they have never been worthy so close a study as now, when they have run into all the forms of our gardens; when they have so far disguised themselves as to make their very origins matters of speculation. Why have they varied, how have they varied, how much can they vary, what is their relation to soil, to light, to heat, to moisture, to pollination from other varieties or species — in short, what does botany tell us of the rose under cultivation? Nothing. We don't know the meaning of a rose; if we did, who knows but that we should find a key to many of the secrets of the vegetable world? The botanist throws it aside because it has lost its permanent specific characters; he cannot name and classify the perplexing multitude of forms. But the very fact that the plant is so perplexingly variable is all the more reason why the botanist should aid us in its study. Said Darwin: "One new variety raised by man will be a more important and interesting subject for study than one more species added to the infinitude of already-recorded species."

We must get below the surface indications. We need to know the principles which underlie our experiments before we experiment, or else we must experiment for the purpose of discovering the principles. Experiment is rife to-day; the empirical spirit of the age is contagious. Every one experiments or investigates.

The greater part of this experiment is the reflex — the echo — from the scientific tendency of the times. It commonly has little scientific basis and no permanent value. People are experimenting to find out what they ought to know without experimenting.

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Every experimenter must know what experimenting has been done already. He must be an educated man. Experiments are often interpreted incorrectly; they are said to teach what they do not teach. A person sows land-plaster on one half his wheat-field and leaves the other half unfertilized. Upon the plastered portion the wheat is four or five inches higher than on the other. Therefore, says Quizicus, plaster produces a great increase of wheat, not thinking, however, that growth of straw is one thing and yield of wheat another. A gardener had two rows of onions. Upon one he applied guano, upon the other bonedust. One yielded four bushels more than the other, and he attributed the larger yield to the fertilizer; but under the same treatment they would, undoubtedly, have varied as much. An observing fruit-grower possessed a plant of smooth-fruited gooseberries. A favorite family cat, having unceremoniously died, was buried underneath the bush, and behold! the next year the bush bore hairy berries, and has so continued to do until the present day! Most of my neighbors keep seed corn by stripping the husks and braiding them together and then hanging the ears in a dry loft; but one, more acute than the rest, one year hung his corn in a hoghouse, by way of experiment. The next year his corn failed to grow; therefore, said he, corn hung in a hoghouse will not grow. This is akin to the valuable experience of a certain Irishman, to whom rhubarb was given in a case of sickness. He recovered. Shortly after, his neighbor, a Dutchman, fell sick, and Pat administered the rhubarb. The man died. Pat hastened home to write on the fly-leaf of his Bible: "Medicine which will cure an Irishman will kill a Dutchman." Surely, experiment is in the wind. Even the city editor has caught the contagion and writes: "I am building up an article on potato-rot. What insect causes it? How does the rot get in its work? Is it more prevalent when cholera is raging?"

Of a surety, we need our botany and chemistry and zoölogy and meteorology in the garden. We need intelligent investigation. Moreover, we need extensive and extended investigation. If we need one thing more than another, it is that the botanist shall climb the garden fence and include within the realm of his science all the plants which we till. Even Knight made this de-

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mand nearly a century ago: "I cannot dismiss this subject without expressing my regret that those who have made the science of botany their study should have considered the improvement of those vegetables which, in their cultivated state, afford the largest portion of subsistence to mankind and other animals, as little connected with the object of their pursuit. Hence, it has happened that, while much attention has been paid to the improvement of every species of useful animal, the most valuable esculent plants have been almost wholly neglected. But when the extent of the benefit which would arise to the agriculture of the country from the possession of varieties of plants which, with the same extent of soil and labor, would afford even a small increase of produce, is considered, this subject appears of no inconsiderable importance. The improvement of animals is attended with much expense, and the improved kinds necessarily extend themselves slowly; but a single bushel of improved wheat or pease may in ten years be made to afford seed enough to supply the whole island, and a single apple or other fruit tree may, within the same time, be extended to every garden in it."

There are a few who have surmounted this garden fence at some of its highest points, and of these, none stand out so clearly as Charles Darwin, the grandest horticulturist of any generation, the man whose work pervades all scientific thought to-day. It is not the man who tills the soil who is necessarily the best horticulturist, it is, rather, he who knows nature best, and who can put his knowledge into form for others to use. A Darwin, although he never held a hoe, can do more for the permanent and profitable advancement of horticulture than all the horticulturists of New England. Out of this great wave of unscientific experiment which floods our land, we shall one day expect another Darwin to rise, who shall reveal to us more of the methods of nature than we can dream of to-day.

The art, the handicraft, of horticulture is well understood; but every part of it which touches a science demands further investigation. We do not know the scientific principles which underlie these handicrafts.

Of the subjects of science which have been worked out, I know of none so thoroughly done as pear-blight. Indeed, the re-

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searches of Burrill and Arthur, during the last five years, may be taken as the type of successful investigation regarding the diseases of plants. We hear much nowadays about parasitic fungi and their action upon the plants of our garden, and in many cases we can apply efficientr emedies or preventives. We are inclined to regard the whole subject as one well understood, while, in fact, very few are so imperfectly understood. We have not yet been able to describe, to become acquainted with, the outward appearances of many of these fungi, and in comparatively few cases do we know the whole intricate round of life of the species. But we must soon begin to learn another set of facts; we must discover the relations which exist between the nature of the lost plant and the aggressive fungus. Why is it that the red-rust always attacks the Kittatinny blackberry, while some others sorts are exempt? Why does the bean-pod fungus attack the white wax variety in preference to others? We say that one variety has a thicker epidermis than another; that it is a more vigorous grower and is, therefore, enabled to resist the attacks of the fungus; but these notions are indefinite. The fact is, we don't know why one variety resists a fungus and another does not. If we did, one of the problems of our horticulture at present would be the breeding up of fungus-proof plants upon scientific principles. If there is any attempt in this direction at present, it is entirely haphazard. Not many years since, the notion was entertained by many scientific men that the peculiar objects which we know as parasitic fungi were not distinct organisms, but simply modified cells of the diseased plant. We have now outgrown this notion; but we are, nevertheless, far short of solving the mysterious relations which exist between the fungus and the plant upon which it grows. We have emerged from one difficulty but to encounter another. The things which we do not know about horticultural science are astounding in number and importance, and they pertain to the commonest operations of the garden as well as to the most difficult and extraordinary. Let us examine, for instance, the simple matter of grafting and budding, which, so far as the art is concerned, is as well understood as tillage itself. It was practiced by the Romans. We bud our fruits as they did, but we know little more than they concerning the principles of the

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operations. What do we know of the laws of affinity between plants, — laws which enable us to determine the limits of grafting? Some pears thrive upon the quince, some do not; but the quince does not thrive upon the pear. The pear is short-lived and unsatisfactory when grafted upon the apple, which is very near it in botanical kinship; but it does just as well, it is said, upon the thorn, which represents a distinct genus. The peach takes poorly on the apricot, but it and the apricot thrive on the almond and the plum. Most plums do well upon peach roots, but the Canada Egg commonly fails to unite, and the Lombard makes such an imperfect union that it soon breaks off; still, between these plums and others, we can discover no differences to account for these peculiar behaviors. Sweet cherries do well on the Mahaleb cherry, but the Mahaleb will not succeed on the sweet cherries. The gooseberry will not grow on the edible currants, but it thrives well on the wild buffalo currant of our West. A certain Chinese orange almost fails to bear upon its own roots, although it becomes very prolific when grafted on one of the lemons, a distinct genus. We know scarcely anything of the influence of stock upon graft, and we are unable to discriminate, in most of the recorded facts, concerning the matter, as to whether some change in the scion is produced by the stock upon which it grows, or by soil, climate, or culture. Still, the subject is one of immense practical importance. We may have a tree with plum roots and almond leaves, and the trunk may be composed of both peach and apricot, but we have no knowledge of the physiological relations which exist between the parts of this composite individual. We have a few facts concerning some indefinite influence which the scion exerts upon the stock. An experienced nurseryman habitually looks ahead, when he is digging trees, to note the character of the tops of the trees he is about to dig, knowing that a very upright grower will have a tap root, and a very bushy grower a spreading root. But the top is the scion and the root is the stock; how is it possible that the scion can influence the root upon which it grows? Many shrewd nurserymen tell us that if we graft a plum upon the young root of a peach, in a few years the peach root will change to a plum root, the identical fibers which were once peach become essentially plum in their external features. Variegation has long

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been noticed to be an occasional influence of scion on stock. A stock with ordinary green leaves is sometimes forced to produce variegated leaves by inserting a bud from a variegated variety; and this is all the more singular from the fact that the buds themselves often fail to grow. The stock may be influenced in this wonderful manner below the insertion of the bud as well as above it. If we attempt to explain this mystery we but unlock other mysteries. What is variegation? What causes it? Some contend that it is a contagious disease, and that budding is an inoculation. I find that so long ago as 1727, this idea was advanced; for Prof. Bradley, of the University of Cambridge in England, observed, "that the distemper which shows itself in the yellow and white variegations of the leaves of the common white jessamine, and several other plants, may be communicated to every plant of the same tribe, by inoculating only a single bud of the variegated kind into the others which have plain green leaves; and, though the bud does not live, yet barely by the application of it to the healthful tree, we shall find the yellow blotches or variegations of the unhealthful bud communicated to every part of the healthful plant. Just as it happens when a man has had the small-pox inoculated upon him, his whole mass of blood will become infected with the poison." We are little wiser upon this point than Bradley was. Now, there is on record a case in which an entirely distinct plant, once regarded as a true natural species, was produced by grafting a scion of one species upon a stock of another. A hybrid was produced by grafting. Did we know how and why this came about, might we not apply the principle indefinitely? Now, we have the remarkable statement that a certain Italian, through long study and experience, has hit upon a device by which he can produce new varieties of roses by the simple art of budding. Whether or no this statement be true, it is, nevertheless, a straw which indicates a current. The more we study this apparently simple matter of budding and grafting, the deeper we are surrounded by an impenetrable maze of mystery; we are everywhere limited by the unknown — unknown. I am not to be understood as saying that we have made no advancement in grafting. Columella declared that he could grow several kinds of grapes in a single cluster, by tying together cuttings from

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four or five varieties, enclosing them tightly in an earthen tube, and burying them in the soil to grow together. In this manner he said that a compound vine could be produced, which would bear many-fruited clusters. He would produce seedless grapes by splitting his cuttings, removing the pith, and then placing them together again! He also detailed a device by which "scions of all kinds may be grafted upon all sorts of trees whatsoever." The Romans evidently had little notion of the affinity of species. Virgil would produce a curious medley: —

> "But thou shalt lend
> Grafts of rude arbute unto the walnut tree,
> Shalt bid the unfruitful plane sound apples bear,
> Chestnuts the beech, the ash blow white with the pear,
> And under the elm the sow on acorns fare."

We should expect that the horticulturists of to-day should not hold such notions as these; verily, there has been advancement, but for the most part it has been a stumbling advancement. Our Pegasus is blind.

Let us return to the botanist. Our curiosity is excited as we see him strolling critically over the fields, collecting-case in one hand, botany in the other. How does his botany help him in his rambles? Is it possible that he can identify all the multitude of forms of vegetation with names and descriptions? He can; and herein lies one of the wonders of botanical science. The classification and the method of naming are such that the diligent botanist can hold in his mind the names and the kinships of thousands of plants with no tax upon the memory. There is no system of arrangement so complete, no logical method of subordinating a lesser character to a greater so thorough, as the systems of classification and nomenclature which we apply to wild plants and animals. On the other hand, there is no system more bungling, none more thoroughly haphazard, than that which we apply to the plants of the garden. Is there not some way to get our classification and nomenclature over the garden fence? If the subject is beset with difficulty, so much the more do we need system, and so much greater will be his honor who constructs it. I hope to see the day when the gardener can botanize intelligently

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in his garden; I hope to see a handbook which will aid us in the determination of garden varieties. And this, you must admit, would be an exceedingly "practical" sort of a volume. It would endeavor to give us the synonymy of each variety; it would tell us, before we make our spring order for seeds, whether the Leyden White Summer, the Satisfaction Black-seeded, the Black-seeded Yellow, the Fine Imperial Cabbage, and the Berlin lettuces, are in fact distinct varieties, or whether they are all names for one and the same thing. This is an exceedingly important matter, to find out if many of our common varieties are really distinct, and to hunt out the oldest name for a permanent appellation. It must be investigated with great care, and upon a scale not profitable for the individual gardener, who must live by the sweat of his brow. It must be investigated by persons who have trained eyes. In this direction the New York Agricultural Experiment Station is a pioneer in this country, so far as I know. Each year the Station garden grows some one vegetable in all its varieties, for experimental purposes. In the Station report for 1883, fifty-eight varieties of beans are accurately described and compared. Progressive horticulture demands that some efficient system of classification be worked out for each of our orchard and garden plants. It is by no means a satisfaction, if we wish to find the name of some apple new to us, to be obliged to know the name before we can find the name in an alphabetical arrangement.

We must learn the possibilities of native wild plants. It is in this direction that we must look, in many cases, for increased hardiness and productiveness. Our Wild Goose and Miner plums indicate a new field for advancement in plum culture. Our wild black currant and dwarf sand cherry are awaiting investigation. We must breed the bitter lining out of the pecan and the big seeds from the papaw. We often account it a fortunate circumstance that the cradle of the human race was rocked in southwestern Asia, the home of fruits, the land which flowed with milk and honey. But if the Garden of Eden had been in America, our heritage would have been as great, perhaps greater. The possibilities of our wild fruits as a whole are great. Already our gardens are planted with native grapes, native strawberries,

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native raspberries, native blackberries, and native cranberries. The native species are by no means all utilized. A fertile field of future experiment will be the growing of edible fungi. Many wild species are agreeable and wholesome, but so far we have succeeded in cultivating but one, the world over.

Gardeners are familiar with "sports," those occasional mysterious plant forms whose advents are unknown until they suddenly appear. The phenomenon itself of sporting is known of late, since the work of Darwin, as bud variation, a term of great importance to the gardener, as malaria is to the doctor, since it covers volumes of ignorance. Cherry trees which habitually bear red fruit sometimes produce a branch which bears white fruit. Yellow plums have been seen on certain branches of a purple-fruited tree. Greening trees sometimes produce russet apples, and russet trees sometimes produce greenings. Potatoes are sometimes half white and half purple, and planting one side or other of the tuber will often reproduce the peculiarity of that side. Weeping branches appear on trees of upright growth. Variegated or curiously cut leaves appear suddenly on many plants. Plants so unlike all others as to be called distinct species have originated by bud variation. In this manner the moss-rose probably originated, and certainly the nectarine is a sport from the peach. We know nothing of the causes of bud variation. We shall expect to some day discover many and diverse causes for these fitful phenomena. Did we know these causes now, we might apply them to the production of better fruits. Sport is certainly a relative term. It is a sport to-day, because we do not understand it; to some horticulturist of the future it will be but the operation of a law.

We sow with the confidence that like produces like, that as we sow so shall we reap; but the keen observer sees in the offspring of almost any seed, when sown in considerable quantity, a wide variation. Indeed, no two individuals are alike, although they spring from seeds grown in the same fruit. Plants have individual characters just as clearly pronounced as do people, and so imperceptibly do these characters widen in all directions that we cannot say when any character ceases to be individual and becomes varietal; that is, common to a number of individuals; or

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even when it becomes specific or permanently common to a class. Thus it happens that characters which are in the judgment of one man varietal are in the judgment of another specific, or may be even individual. "Species are judgments," said a great botanist; and, necessarily, he who has the best judgment and the most experience is the best judge of character in plants. Such judgment is of supreme importance if one would enter the higher fields of modern horticultural research. Often the seeds from the same pod will produce plants very different in their characters; the seeds "break," as the gardener phrases it, and we get what we call new varieties. Why? We say that it is due to peculiarities of soil, of culture, of climate, of some previous influence of pollen, or something. Surely it is due to something; so far we are correct. Reasoning from this known tendency of plants to vary, people often construct curious notions, which lie entirely without the limits of possibility. These limits are readily distinguished by the botanist, but cannot always be detected by others. Here we find an explanation of those antagonistic notions which have been a feud between the farmer and the botanist; the notion on one side that wheat turns into chess, and on the other side that the supposition is absurd. It is curious to what extent this ideal transmutation of species is often carried. As early as 1747 a Latin dissertation, written under the direction of the learned Linnæus, was published in Europe, to disprove the fallacy that wheat turns to chess. The notion has even an older history than this. The idea that certain grasses regularly transform into each other is as old as recorded history. It is said that in early times the peasantry of Europe had discovered a regular series of transformations, due to poor soil, from wheat to rye, then to barley, then to darnel grass, then to chess, and finally to oats. And it was also declared that the reverse conditions of a fertile soil would evolve wheat from oats through the same intermediate plants! At the present day, and in portions of our own country, chess and clover degenerate into timothy, and horse-hairs grow into snakes! And the people who observe these unorthodox pranks of nature are often among the first to scorn the idea of evolution, which attempts to account for the instability of species in a scientific manner.

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We secure new varieties of plants largely by random. This method is unscientific, and, to the student of natural science, is unattractive. We do not know the possibilities which lie in a seed. Sometimes seeds contain two embryos, two initial plantlets. It was once observed that two per cent of a lot of young osage orange seedlings were united twins; the seeds had contained two embryos or germs, and the young plantlets had grafted themselves together. A still more remarkable case is that in which two very dissimilar plants were obtained from one seed of a fuchsia, the double-embryo seed, in this case, being the product of cross-pollination. We do not understand the mysterious effects of soils upon young seedlings. Prof. Tracy, of Michigan, sowed pease of one variety in a row which extended from poor soil to rich soil. Upon the rich soil he obtained a new variety of pea which reproduced itself from seed. We say that strong soil was the cause; but the same thing would probably not occur again in many years, under conditions which, so far as we could judge, are exactly similar. We do not know why some varieties or species of plants are more variable than others. Some cultured varieties will reproduce themselves with remarkable permanency from seeds, others will not. These fixed varieties, those which come "true to seed," we designate as something more than varieties; they are races. We have a name for them, as indeed we do for most of the phenomena of nature; and I often think that there is a tendency to crawl under these technical names, and to applaud ourselves with the idea that we have picked the meat out of nature's puzzle. Seeds from the young plants appear to produce a better and more variable offspring than those from old plants of the same species. Dr. Van Mons, of Belgium, inspired by this fact, built for himself a permanent name in the science of horticulture. He selected seeds from the first fruits of young trees, especially from young trees of new varieties, and planted them. From the first desirable fruits of the seedlings obtained, he again selected seeds and planted, and so continued to do for several generations. Each succeeding generation fruited sooner than the preceding ones and produced better fruit, until about the fifth generation, beyond which there was no increase. The fifth generation of pears bore at three years from the seed.

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Van Mons proved that by selecting seeds from these young plants, which are in "a state of variation," whose characters are not yet fixed by age, we shall rear the best seedlings. And here another question arises. If the characters of young trees are not yet fixed, will the first fruits be the same as those which the tree will bear in maturer years? Are the habits of the boy the same as those of the man into which he grows? We know that in many cases they are not. But here we find a fact that we should not expect from the conclusions of Van Mons; the first fruits of the tree, if they vary at all, are commonly inferior to the later fruits. Still these same inferior fruits give a superior progeny. Would it be possible by root-grafting scions from a seedling at different times during the first four or five years of its existence to secure different varieties of fruit? We shall try it.

Verily, we do not know the possibilities of a seed. We need well-directed, extended experiment. We need to plant very many seeds of every useful plant, under conditions as nearly alike and as much unlike as possible, and to make a numerical record of the peculiarities of variation. Do they vary most constantly in this direction or that? We may then be able to discover some law of variation.

In a general way, we have hints as to some causes of variation; but here, as elsewhere, we are obliged to cover our ignorance by a technical term. Certain conditions of vegetation attend certain climates, and we habitually refer those conditions to climate as a cause. This disposition by no means discloses a specific cause, however. Climate is ambiguous. In common usage, it includes latitude, heat, moisture, drought, winds, intensity of sun's rays, electrical conditions of the atmosphere, and other phenomena. We must analyze climate and study the effects of its component parts. Here is a field which is wonderfully fascinating, from the fact that it deals with problems of such magnificent proportions; it includes at once, within its scope, the whole world, with all its depressions and elevations, its currents and counter-currents, its land and its waters, its winds and its calms. It traverses every unknown country, under the lead of versatile Von Humboldt, the father of botanical geography; it visits the islands of the sea and climbs the awful ranges of the Andes and

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the Himalayas. On the other hand, it recognizes every local distribution of heat and cold. We are becoming familiar with some of the results of a change in latitude and climate, but we can scarcely frame laws. When a vegetable is taken North, it usually becomes dwarfed. The average height of Indian corn in the Gulf states is twelve feet; in Canada, six feet. Compare our Yankee corns with the Southern dent. Many woody perennials of the South become herbaceous annuals at the North; castor-beans and cayenne peppers are examples. The apples of Northern Russia grow on bushes, rather than trees, which are planted in hills after the manner of corn. Aside from dwarfing, plants usually take on different forms as they are taken northward. The tops are lower and rounder. In lower latitudes, they incline toward a pyramidal or fastigiate shape. The lower branches of conifers are proportionally longer in Canada than in Carolina. There is evidently a greater tendency at the North for plants to sucker and to produce underground stems. Although northern latitudes induce dwarfing, the amount of leaf surface is proportionally larger than southward. As checking growth induces fruitfulness, we can readily understand that plants are commonly more productive northward, so long as the climate does not interfere with the health and maturity of the plant. As a rule, however, it appears that the fruit of any species increases in size as we go south, but the number of fruits to a given extent of plant surface is greater northward. A recent census gave the average yield of wheat per acre as 14.2 bushels in the upper ten Atlantic states, and 9.8 in the Gulf states, and 30.66 bushels of oats against 14.2 bushels. The latitude of the greatest productiveness of any plant is usually north of the latitude of greatest growth; *e. g.*, if a plant reached its greatest size at 40°, its greatest productiveness might be at 45° or 50°. If dwarfing produces fruitfulness, without producing serious concomitant evils, it is desirable; for while we may lessen the actual amount of production on each plant, we can grow many more plants to the acre. The increase in plants can be much greater than the decrease in individual production, but there must be a limit to profitable dwarfing. The most productive ratio of size of plant to the amount of fruit it bears is an important and entirely un-

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solved problem. It has been stated that in England the most profitable ratio for wheat is about ten parts of straw by weight, to seven parts of grain. Given, the profitable ratio and that latitude where this ratio will be naturally developed, and we have the essentials of a great advance in intensive horticulture. Seeds could be distributed from the given station; and even if we were not able to produce distinct varieties, which should possess this ratio as a permanent character, the seeds could be frequently distributed. We are gradually approaching this climax. Northern-grown seeds are now in great demand. This fresh stock, this change of seed, is of great importance in many respects, of which the feature I have detailed is perhaps the most important, though the least understood and most neglected. By selecting seeds from a certain locality we are enabled, with a great degree of accuracy, to secure the salient features of the plant in that locality. "The enhancing of any peculiar feature of growth may be done by bringing seed from a climate which has that tendency." Latitude, or some of the conditions of climate which accompany latitude, has a potent influence upon color. Northern fruits, like northern maidens, have ruddy cheeks. In old Russian song is a marvelous maiden whose neck was like a swan, whose lips were like cherries, and whose cheeks were as red as the Volga apples. The object and the figure are attractive. The beauty of Alpine flowers is proverbial. On the unfrequented slopes of high mountains, fringing the perpetual snows, are the prettiest flowers the world affords. In vain do we search for the cause. It is pleasant to entertain the proposition of Wallace, that these bright Alpine colors are usually gaudy advertisements to insects, which are rare upon high mountains. The reciprocal relations of flowers and insects are always absorbing; but although the fact that Alpine flowers produce unusual quantities of nectar appears to uphold Wallace's hypothesis, we must nevertheless forego the pleasure of its entertainment. We find the same gaudy colors where insects are common; moreover, we can produce them in short periods by a transfer of culture. Perhaps we are beginning to solve the problem in the recent studies of the intensity of sunlight at high altitudes and latitudes. As we learn more upon this subject, we shall undoubtedly be able to control to a great extent the colors

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of our flowers. Indeed, Flahault had fourteen species of ornamental plants sown the same year in Paris and in Sweden, and of these, thirteen produced much brighter flowers in Sweden. The study of the intensity of sunlight will probably enlighten us upon the causes of high flavor in northern products, for be it known that high latitudes increase flavor in fruits; I am not able to verify here my above comparison in regard to maidens. We must know why it is that our apples and vegetables and corn are better at the North. It is lately asserted that even the watermelon, when well grown and thoroughly matured, is probably better at the North than at the South. If the world will still persist in accusing Brother Jonathan of trickery, it must, nevertheless, give him credit for honest, concentrated fruits. Hot climates develop poisons and aromas. Aromatic plants are characteristic of deserts the world over, says Wallace. I have in mind a pleasant incident of opening a bundle of dried plants which were picked twenty-five years before in the deserts about Palestine, and so strong was their fragrance that it filled the room with "Sabean odors from the balmy fields of Araby the blest." The historic hemlock of which Socrates drank loses its virulence when grown in Scotland, and our sassafras loses its odor when grown in the cool summers of England.

Our studies of the relations of plants to climate must deal with acclimation, — a subject held in such different estimation by different observers that while the eminent Prof. Lindley has great hopes for its future, Peter Henderson declares that "a life-time spent in the practical study of horticulture has forced me to the conclusion that there is no such thing as acclimation of plants." Corn, for instance, does not succeed in England. This diversity of opinion may arise, in part, from different understandings of what acclimation is. To one, acclimation means an entire change, a revolution in the constitution of a plant, so that it can exist in opposite extremes of climate; to another, it means a series of minor changes, taking place gradually, so that the plant can be cultivated or become naturalized through small but constantly widening circles of differences. The first notion supposes no limits to acclimation. So far as I know, it is unreal. The second notion, that of gradual acclimation and naturalization, is

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abundantly illustrated in every garden and by every roadside. It accepts the common observation that there are limits to acclimation. We cannot grow water-lilies on a sand-hill or corn in a damp and cloudy climate. We are not able to say whether we can induce some entirely new change or series of changes to take place, in order that the plant may become accustomed to some radical difference in climate, or whether we simply intensify or draw out some latent tendency to variation, which exists in the plant in wild nature. Of the fact of acclimation, however, there can be no doubt. Plants adapt themselves to colder climates. In fact, the dwarfing consequent upon transference to higher latitudes is itself an adaptation, from the fact that the plant requires a shorter season in which to mature. The individual character of the plant is, in some instances, mysteriously changed. It is stated upon good authority that twenty degrees below zero in Michigan is no more injurious to a given variety of peach tree than zero in Mississippi. We have numberless prophetic facts concerning acclimation, but of its possibilities we know almost nothing. Our science must climb the garden fence to solve the problem. It is possible that we must begin with the seed itself if we would acclimate. It has been thought that the reason why northern-grown seeds germinate quicker than others, in spring, is because the cold of winter produces in the seed an increased sensitiveness to heat and cold. Indeed, individuals of the same species were once kept, some in an ice-house, others in a warm cellar, and the former vegetated sooner and grew faster in spring than the latter. Upon this suggestion I am now experimenting with seeds, cuttings, and scions.

If we would fully understand the laws of variation of cultivated plants, — whether the variation is in the direction of acclimation or otherwise, — we must know the origin of the plants; we must know how they have varied in all previous times. The origins of many of our cultivated plants are lost in the mists of antiquity. They antedate civilization; they sprang from untaught nature, coincident with man. The primeval ancestors are lost. We search the records of every ancient people, and our perplexity is often rather increased than diminished. Sometimes history is altogether silent. How, then, can we know the unrecorded past?

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If man, by cultivation, has evolved our plants from wild nature, why cannot man, by a reversal of that cultivation, breed back to the originals? The common radish is unknown in a wild state. When radishes become spontaneous, or self-sown, about the borders of the garden, they lose many of their valuable characters. Their roots become somewhat smaller, much tougher, and the aspect of the plant is changed. Three acute observers — botanists necessarily — observed that the variations of these self-sown plants are in the direction of a certain so-called wild radish, which is a weed in poor soil, along the Mediterranean and in some places on our own Atlantic seaboard. This plant has a slender, woody root. Thereupon Carriere, a French experimenter, sowed the seeds of this wild plant in the autumn in good soil. The plant found itself in a new predicament. It could not flower before winter came; and, with the elasticity of organization so peculiarly characteristic of natural objects, it formed a thick root, in which was stored nutriment for the growth which must be delayed until the next year. Seeds of these plants, and of their offspring until the fourth generation were sown, when Carriere found himself in possession of perfect radishes! Now we can picture to ourselves the first radish. Seeds of the wild plant became scattered to a fertile soil. They germinated in the autumn. Some person, more acute than his associates, noticed the sleek, thickened root and tasted it. It pleased him; he watched other plants like it; he sowed the seed. Many biennials, — turnips, carrots, parsnips, — sometimes "break" the first season. Instead of producing fleshy roots, they "run to seed." This appears to be a reversion. Seeds from such plants commonly produce annuals instead of biennials.

The poet Goethe and Saint Hilaire proposed a law which states that when nature expends energy in one direction she spares it in another. There is always an equilibrium of force. There is a constant amount of coin in the treasury; and nature, the scrupulous manager, economizes in stocks when she speculates in crops. We need more proof of this statement; we need to know if it is a law. We are already aware that the number of seeds in a cultivated apple or pear are less than in the wild fruits; do the numbers and sizes of seeds decrease in proportion to increase of

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improvement? Many fruits have become seedless; man has bred out of the plant the power of perpetuating itself. The banana is a familiar instance. We are familiar with the fact that checking growth induces fruitfulness. We produce fruit at the expense of growth. Old and decrepit apple trees often bear profusely, as if in the endeavor to increase their progeny with their last effort. Poor soil and indifferent culture often produce depauperate plants, and such plants usually blossom prematurely. The intelligent gardener is aware of this fact, and is enabled, in many cases, to produce a race or variety of dwarfs. Here is also a promising field for scientific experiment. Given this law, and we shall sow the smallest seeds, from the fewest-seeded fruits, when we wish to secure new varieties. Here the garden fence was first let down, so far as I know, by the New York Experiment Station.

Running alongside these curious facts are others still more curious. We know that a plant becomes variable when it is cultivated. In their wild condition plants are commonly in a certain state of repose. Grown for centuries under certain conditions, they have become accustomed to their surroundings, fitted into the niche wherein they have found themselves. Their characters become hereditary because they are not disturbed by surrounding objects and conditions. There is a sort of an interbalance between conditions and plants, and when these conditions are changed the probabilities are that the plants will change also. When the tramp got into clean clothes his conditions were changed, and he declined to sleep on the sidewalk. Some plants adapt themselves to new conditions more readily than others; they begin at once to vary in habit and character. Others show no change for some time, — for years, perhaps, — when suddenly they begin to vary, and their original identity may soon be lost. During the first years of their civilization they store up variability which will some day break out into forms whose name is legion. This phenomenon has been called the accumulative effect of cultivation, — a good enough name for an occurrence, a fact, for which we have scarcely a hint of a cause. The direction of variation we can determine largely for ourselves. Here, for once, does man lead nature; ignorantly, perhaps, but still leads. He

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leads the plant in the direction of larger roots, sweeter leaves, finer fruits. He could lead more certainly and more rapidly if he knew the whys and wherefores, the bogs and the quicksands, the hard grounds and the mountains, which lie along his path. But with these greater changes come minor ones, which are in some way related to still greater ones which have not appeared. I wish to call your attention to the fact that as variability increases the pollen begins to vary; that delicate, vital dust, which may float in a sunbeam, or which may be carried a thousand miles on the wings of the wind, is influenced by the behavior of the plant. We know little concerning this wonderful fact; we have a hint which is snugly fenced about. It remains for some one to study, develop, and apply it. We cannot trace it to its end even in imagination. We do not know whether this is the first or the last of the phenomena of variation. We do not know if every successive generation varies more because the pollen which impregnated, fertilized the seed, varied more. In short, we do not know that this variable pollen does induce variability, although we suppose that pollen from a cultivated plant produces a more variable offspring than does pollen from a wild plant.

But what is this cross-fertilization, this cross-breeding, this hybridizing, which is in every one's mouth, and which flits as an undefined something before the eyes of the farmer of to-day? It is nothing new; its literature is voluminous; gardeners will talk about it in the most commonplace and familiar manner. Its influence has been felt for a quarter of a century as a great tidal wave in the science of horticulture. It is simply transferring the pollen from one flower to another, and then sowing the seeds which result from the fertilization; these seeds will probably produce plants in some manner intermediate between the two parents. This is the gardener's definition. It explains itself; we understand it; we have few or no doubts concerning it. The fresh graduate of the high school has finished natural philosophy; he has learned by rote the definitions and the illustrations in Wells or Quackenbos. He knows it all. In all the book there are no doubts; the statements are definite and positive; there is nothing more to be discovered. Between the covers of our little volume lies all our knowledge of the motions and properties of

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bodies, of the mechanics of levers and pulleys and wedges and screws, of the wonders of electricity and magnetism, of the laws which govern the weather and the features of the heavens; it is all there. The graduate from the college has studied chemistry and mechanics and physics and electricity and meteorology, but his knowledge is unsatisfactory. He is impressed with what he don't know. His knowledge is relative and negative. He has got beyond the covers of the text-book. He sees every branch of his study widening and widening into infinity; there is no end. We are frittering away our efforts on the surface of this wonderful sexual relation of plant to plant, and are contented if, perchance, we reap a result. The ancient farmer tickled the earth with a sharp stick, and was satisfied with his harvest: the farmer before me plows deep; he subsoils; he is never satisfied with his harvest. He succeeds best when he weaves no hit and miss into the acres of his farm. The gardener does not know the laws by which the warp and woof are woven into this mysterious fabric which binds plant to plant in sexual kinship. Said Lindley, a pioneer in horticultural science: "Hybridizing is a game of chance played between man and plants." An Englishman crosses his dahlias and sows the seeds. From 30,000 seedlings, he gets an average of ten good plants. Another calculates that out of 2,000 seedling cross-bred chrysanthemums, he gets, on an average, one good plant. In many cases the ratio of good plants to poor ones is much higher, and in a very few instances we can predict results with tolerable accuracy. Still, the matter is, at best, haphazard; it is not scientific.

There are several degrees of crossing, as practised by man. A transference of the pollen from the anther to the stigma of the same flower is close or self-fertilization; it occurs often in nature, but is rarely practised by the cultivator. If crossing takes place between different plants of the same species, as between a Baldwin apple and a Swaar apple, or a Marrowfat pea and a Tom Thumb pea, the product of the crossed seeds is styled a half-breed; if it takes place between entirely distinct species, as the pumpkin and the squash, pea and bean, the product is a hybrid.

But now we must ask ourselves what a species is. We must define our definition. The botanist tells us that it is a plant

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which, in wild nature, reproduces itself, or very nearly itself, from seeds for successive generations. The sugar maple, the apple, the quince, the dahlia are species. But the different sorts of sugar maples, — as the black, the curled, the birdseye, — and the different sorts of apples, quinces, and dahlias are not species: they are varieties; some of more permanent and important character than others. Nature makes species, and also varieties, but man can make only varieties. But we have already seen that man can produce varieties which "come true to seed": we call them races, but why are they not species? Simply because man has produced them. Many of them we should call species in wild nature. It depends upon which side the garden fence we stand. If we are on the outside, we have a species; if on the inside, we have a race. It is like a Chinese paragraph: if we turn it over, we must stand on our head to read it. The botanist claims the plant when it is a part of wild nature, but loses his interest when it becomes immediately useful to man. Is this a legitimate division of labor? Is the scientist scientific? Does a horse cease to be a horse when it is put into the harness? But they tell us that the different races of cultivated plants — as, for instance, the Treadwell and Clawson wheats, the Yankee and dent corns — are not distinct enough from each other to be called species; and, also, that if left to themselves, they will probably soon return into the species from which they sprang. Certainly, many of our races are just as distinct from each other as are many reputed wild species, and we have proof that many of them are just as permanent. What do we know of the fixity of wild species, anyway? Scarcely anything. We have many artificial hybrids which, so far as we know, are just as distinct from their parents as their parents are from each other, which are just as fertile and which appear just as well fitted to fight out the struggle for existence. We do not know why these hybrids possess such and such characters — characters which are often wholly different from any which appear in the parents. We say that they date back in some mysterious way to ancestors. Then let us find out what the laws of this reversion are, that we may make other and better species. At present we cross similar species under apparently identical conditions, but we get different results. Why is

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it? Is nature fickle, or is man ignorant? Hubbard squashes long grown in Framingham crossed with Hubbard squashes long grown in Framingham may improve our seed; but Hubbard squashes long grown in Framingham crossed with Hubbard squashes newly introduced from Michigan will infuse new life into our offspring. This crossing with foreign stock of the same variety is of wonderful importance. It is a principle as boundless in its influence as the science of horticulture itself. Its importance may be gleaned from the fact that, in one of Darwin's experiments, the height of foreign crossed stock exceeded that of self-impregnated stock as 100 exceeds 52, and in fertility as 100 exceeds 3. The principle is of universal application, and all honor is due to Darwin who gave it to us. We do not know even the limits at which plants can be crossed. Sometimes varieties of the same species cannot be crossed, while some species, or reputed species, cross most readily with other species. In short, we know none of the general laws of cross-breeding, and still we believe that there are such laws. If we must learn some of these laws by experiment, we must also learn some from untrained nature. Our woods and fields are nature's garden. For ages the provident mother has been working with winds, and waters, and insects, with soils and climates, to breed up and to breed out her plants. She presents to us a grand puzzle. We do not know whence her plants have come or whither they are tending. We do not know how many are hybrids, born from the beautiful marriage of the insect to the flower, how many are the children of a peculiar clime, how many had their origin in a recent century, or in distant geological time. We are groping, interrogating. Every question which is answered in the woods and fields is answered for the garden. One spirit pervades vegetation. We can scarcely draw a line between cultivation as practised by man and cultivation as practised by nature. "Our art," said Shakespeare, "doth mend nature, change it, rather. The art itself is nature." We must get outside the garden fence as well as inside it. We must demolish the line between science and practice. This is the new horticulture. Deep down in nature's heart, beneath the thorns and perplexity, truths are hid which are vital to the farmer and gardener. Then do not discourage the pursuit of science, how-

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ever much you may have been taught to regard it as opposed to practice. Science is practice. All so-called popular and useful science must be founded upon recondite facts and principles. The more we know of nature as nature, the more readily can we understand nature in the garden.

We fail to catch the butterfly if we chase its irregular flight over the meadow, but the still hunt beside a thistle will bring us a captive. We cannot always reach the result at which we aim in experiment by a direct chase. We quite as often succeed by employing the still hunt of collateral evidence. The experimenter, then, must be a man of skill and learning in more directions than one. To reach the best results he must give his whole time and energies. The college professor, with his classes and his daily routine, can accomplish but little. We must delegate the work to the forthcoming experiment stations.

We commonly look upon the science of botany as affording few avenues for practical research, while we applaud to the skies the results attained by chemistry and entomology; but chemistry often fails just where we expect the greatest results. The chemist finds turnips to be composed largely of water, and declares that they cannot be profitable food for stock, but the old Scotchman, whose turnip-fed sheep are sleek and robust, knows better. The potato is three fourths water, but it is indispensable, because it presents a digestible bulk to the stomach. Chemistry cannot analyze the grip of a man's stomach. Of all science under heaven there is none more eminently practical than this same botany. Many people don't know what botany is. They associate it with the school-girl accomplishment, which aims to chase down a few plants to their Latin names, and to press them in a little book, which is sacrilegiously styled an herbarium. This work bears no more relation to botany than does a party platform to party practice. Botany teaches, not only what a plant is, but what it does and how it does it. There is one botany of names and classification, another of cells, another of the plant as a living and growing organism, and another of mutual relations to all environments. All these are given for the use of man, because he deals with plants in all their aspects. Even some botanists tell us that the botany of names and classifications — the botany of species —

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is well-nigh finished, but when we have named and described every plant upon the face of the earth we must find out what a species is.

The garden is a puzzle. Every leaf and flower is an interrogation point. And why is this true, when we know so many facts in horticulture? Our experiment has been conducted by our so-called practical rather than scientific men. The end and aim of experiment has been to secure more profitable products, rather than to disclose the principles which govern the production of such products. Had we reversed these motives of experiment, had we endeavored to find the why, our horticulture would be much in advance of its present position. Do you understand me? Do you understand that it is more necessary, at present, to discover laws than to strive directly for better fruits and vegetables?

The difficulties in horticulture keep pace with the advancements in horticulture; the more we know the more we do not know. We shall experiment and investigate for a century; we shall solve the riddles of to-day; what, then, shall the horticulturist of the future investigate? We do not know what his puzzles will be, but we know that he will have puzzles. Science is ever new. It has no depth, no height, no boundaries; it stretches away into the infinite. We no sooner uncover one truth than we discover another. Man always anticipates his extremity of want, but never reaches it. Before we exhaust the coal and oil which mother earth has locked in her bosom, we grasp the electric current from the air. Before we shall exhaust our iron and copper we shall learn an easy method of extracting the silver from clay. Man shall always strive. Endeavor is a winsome goddess, who leads us through copses and along hazardous banks, but she never leads us to the ends of nature. The man who loves his garden, and who knows some of its secrets, is impatient for a fuller gratification. Some objects are near at hand and well defined, others are misty on the horizon. He tries to grasp them; they flit away like a pleasant dream; the prosaic garden fence is before him.

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THE BURTON STOCK CAR.

ONE OF THE BEST AND MOST NEEDED IMPROVEMENTS OF OUR TIMES.

It is a strange fact in the remarkable achievements made by the railroads of this country for the comfort and convenience of human travelers, that prior to 1882 there had been little or no improvement in the mode of shipment of live stock, which forms an item of such vast importance. The same method prevailed until then as existed when railroads were first built; and a very small portion of the people know what this "method" has been, and how it has been improved by the humane invention of the company whose name heads this article.

To present to our readers an adequate idea of the cruelty and extreme neglect to which cattle have been and are subjected while in transportation by the old method would be simply impossible. They are crowded into the car until not one more can be forced in, and then they are started on their journey. To say nothing of the violent bumping and knocking about they get while the train is "making up," the neglect to furnish proper food at proper intervals occasions intense suffering among the cattle, and it is only when the train is "side-tracked" for the convenience of the road, generally, that the animals receive food. Then the operation is but imperfectly performed, as they must be driven out to be watered and "jammed" back again; and should it not be convenient to those in charge to feed or water, it is left over till they stop again. The physical needs of cattle call for prompt and sufficient attention, when they are deprived of the free exercise of their own instincts in self-sustenance, and the amount of

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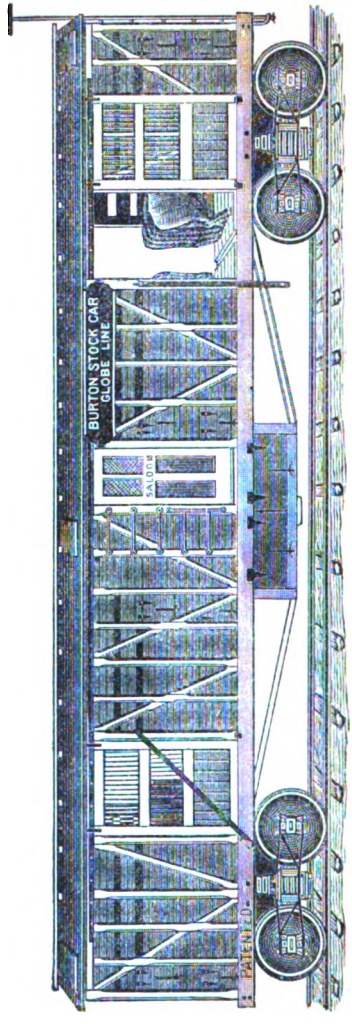
suffering occasioned by this neglect cannot be realized. On the old plan, the attention must be inadequate. It has been clearly



THE BURTON STOCK CAR.

proved that packing cattle in the manner that style of shipment calls for is entirely detrimental to the health and good condition of the beef.

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The frequent "proddings" by cruel and inhuman keepers often results in poisonous sores and malignant bruises, and the constant rubbing together of their bodies transmits the deleterious influences, and the consequences are incalculable. Then, if a steer is so unfortunate as to get down, through weakness, from disease, or lack of food, he is scarcely ever able to rise again, but is trampled under the feet of the rest, and many are thus horribly mangled and rendered unfit for slaughtering. Of course, all this is loss to the shipper. The poorer the condition in which cattle arrive, the less the shipper receives for them, and in the same proportion the consumer is obliged to pay an unfair price for an inferior article of food. The subject of the humane transportation of cattle has been one of deep interest, and has resulted in the invention of the Burton Stock Car, and the formation of the Burton Stock-Car Company, whose design has been not only to present a means for the humane treatment of cattle, but also to land them in Boston and the East in as good condition as when shipped. This they do; and ample evidence of the performance of all they claim is shown by the array of testimonials with which they have been favored, which include communications and indorsements from all the leading shippers throughout the West, and from nearly every point on the coast to which beef is shipped, from Maine to the Gulf. Backed by this evidence of the worth of their car, the Burton Company are confident that they have solved the complex problem of the proper transportation of beef on the hoof.

The car is so arranged that the cattle stand lengthwise instead of across, and is built to hold sixteen head averaging 1,500 pounds each, or twenty head of yearlings or two-year-olds. The animals are watered and fed without removing them from the car, and while the train is moving, the feed being carried in a receptacle for that purpose, and the water supplied by the same cranes that feed the locomotive. In every fifth or sixth car in a train of these cars is a specially apportioned apartment for the use of the attendants, and the many means of connection and easy communication between the various departments make it a comparatively easy task to attend them, and one man can do it in an amply efficient manner. The record of the company is really remarkable,

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one of the feats being the shipment in three days of a load of stock from Chicago to Boston. These arrived in such excellent condition that, instead of being held to be brought up to the requisite standard, they were declared sound, and reshipped at once on board of the steamer. On another occasion this company shipped thirteen cars of blooded stock from Boston to Kansas City, via Fitchburg Railroad, the trip requiring only five days and four hours, and have evidence that they arrived in as good condition as when shipped.

EVILS OF TRANSPORTATION.

No great staple of interstate commerce has been subjected to more grievous exactions in course of transportation than cattle. From the time cattle began to be carried over rails to the present time there has been no improvement in the methods of carrying, no effort by the transporter to mitigate the sufferings of the animals, none to protect the consumer from the hazard of bad meats, and none to cheapen the commodity to the increasing millions to whom it is a daily necessity, or to protect the Western grower in his just profits. On the contrary, the whole business appears to have been given up as a prey to grasping rings, from first to last, by whom producer and consumer have been impartially fleeced, with the active aid and assistance of the common carrier.

In October last this company furnished to the Aztec Land and Cattle Company fifteen cars, to be loaded with the same class of cattle as the same number of common death-pens, and run between the same points. The following is the result, as reported by Mr. Erskine R. Merrell, of Walter C. Weedon & Co., Kansas City: —

"The shrinkage in the common cars was 110 pounds per animal, which aggregates 79,200 pounds, and which at selling price, 2¾ cents per pound, equals $2,178. Those in the Burton cars shrank 55 pounds as against 110 pounds in the common cars. These cattle were loaded promiscuously from the herd at Arizona into Burton and common cars, allowing the Burton cars forty minutes start, which was deducted at the end of the run. The saving in favor of the Burton cars was $1,089 on this one shipment, besides gaining four entire days in point of time — that is,

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the stock loaded in the Burton cars arrived at Chicago four days earlier than those loaded in the common cars. The stock in the Burton cars was in so much better condition as to have obtained twenty-five cents per hundred weight better price, making an additional gain of $1,386, or a total net profit over the old stock cars on this one lot of cattle of $2,475. The distance from Holbrook, Ariz., to Chicago, Ill., is 1,705 miles."

Naturally shippers, and particularly shippers of valuable stock, sought these cars so eagerly that the railroad companies were put to their wit's end to find excuses for raising the rates to a point high enough to prohibit their use. They would put on one day a rate which seemed sufficient to "snuff out the enterprise," only to find on the next that many shippers were still willing to pay it, and saw their profit in it. Instead of paying the mileage, as in the case of other "foreign cars," they taxed it both ways, empty and loaded. The Southwestern "Pool" solemnly adjudicated the matter, and determined that five cents a mile each way upon the humane cars was a very fair rate for a steady thing. An appeal to the Railroad and Warehouse Commissioners of Illinois brought a decision sustaining the Pool enormity. On one occasion the Union Pacific took a round $610 on a single Burton car from Kansas City to Los Angeles, Cal.

The situation is this: If the cars were not discriminated against, if they were hauled whenever offered on the same terms as other foreign cars, the company would gather up the business just as fast as it could build cars to do it, and just precisely in that proportion would the business of the concatenated cattle rings decrease.

Repeated tests of the Burton Feeding and Watering Cars by intelligent shippers prove conclusively that from fifty to seventy per cent of this shrinkage in common stock cars can be saved, and the animals landed at market in a shorter time, and in so much better condition as to command ready sale at an advance of from fifteen to fifty cents per hundred more than like cattle bring on the same market shipped in common cars.

The passage of the interstate commerce bill will correct some of the worst of the abuses in this cattle traffic. It forbids rebates, and that would cut off the fifteen dollars per car to the eveners. It forbids discrimination, and that would, if fairly interpreted

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and enforced, compel the railroads to haul improved cattle cars without delay and on fair terms. Still, the iniquities of the stock-yards would remain until the entire business of carrying cattle should be done on the new system. Moreover, any one reading the decision of the Illinois commissioners in the case of the Burton car will see how readily experts, bent upon discrimination, would find pretexts for evading a statute which merely forbade discriminations in general terms — as the interstate commerce bill provides — when applied to a question between common stock cars and improved ones, or between classes of the latter. For this reason, apparently, Hon. Martin L. Clardy, of Missouri, a member of the committee on commerce, has introduced a carefully prepared bill covering the live-stock trade exclusively and thoroughly. Such an investigation as that proposed by the Hopkins resolution would unquestionably result in a statute correcting the abuses in this traffic.

We cite the following as an example to give the public some knowledge of what the railroads of the country have done to bar the use of improved cars.

Mr. Allerton, the "Hercules" of the railroads, attempts to sustain the unjust discrimination of some transportation lines against improved methods of shipping live stock. He makes the false claim that shippers do not want feeding and watering cars, without giving the shippers an opportunity to express their choice.

At the National Cattle Convention held at St. Louis, November 28, 1885, and at the Denver convention, January 27, 1886, ranchmen and breeders from all states and territories were unanimous in their demands for improved cars, ninety-nine out of every hundred advocating the use of cars in which cattle could be fed and watered in transit without unloading; and for the purpose of preventing shippers using improved methods, the Southwestern Pool issued the following circular: —

[COPY.]

"CHICAGO, May 15, 1885.

"Until further notice, the following rules will govern the transportation of 'Burton' and other Palace Live-stock Cars: —

"1st. No mileage will be allowed for such cars in either direction.

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"2d. Cars hauled empty, whether to point at which to be loaded, or returning after being unloaded, will be charged 8 cents per mile.

"3d. Live stock loaded in Palace cars not exceeding 30 feet in length, internal measurement, will be charged the rates provided for shipments in ordinary cars; over 30 feet and not exceeding 33 feet, 10 per cent additional, and a further charge of 3 per cent for each foot or fraction thereof above 33 feet."

Later a different ruling was made, fixing an arbitrary charge of 5 cents per mile on Burton cars, whether loaded or empty, amounting to $25 excess each way.

The Excess Charges unjustly levied in this circular by the Southwestern Pool are more than 50 per cent above the regular tariff, for freight alone, for transporting cattle the same distance in common stock cars, which actually carry from two to four head more each than the Burton Feeding and Watering Cars. For instance, the tariff rate from Kansas City to Chicago is $55 on a common car, which transports from 18 to 22 head of fat cattle. If, however, the shipper desires to save shrinkage and gain time in transit by using the Burton car, which is 38 feet long and has capacity for only 16 adult animals if tied, or 18 if loaded loose, he is required to pay $60 per car freight, and, if said car be returned empty over Southwestern Pool lines, an additional charge of 5 cents a mile is levied, amounting to about $25, or a total of $105 per car; whereas all other foreign stock cars are hauled at regular tariff, and a mileage for the use of same of ¾ to 1 cent per mile, each way is paid to the owners of said foreign loaded cars. The above mileage is paid also to refrigerator car companies, and from 3,000 to 5,000 pounds of ice carried free in each car.

If shippers do not want their stock transported in feeding and watering cars, why is it necessary to make this outrageous discrimination to render their use unprofitable to cattlemen? A complete refutation of Mr. Allerton's assertion exists in the fact that the entire equipment of this popular line of Feeding Cars still continues in use, shippers maintaining that the Burton Stock Cars are still a source of profit to them, notwithstanding the additional charges of the Southwestern Pool for hauling them. Many trunk lines outside the Southwestern Pool recognize the fact that the railroad company's best interests are identical

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with their patrons, and they haul these Feeding Cars for shippers at the same tariff as charged for other cars of equal capacity. If Mr. Allerton had said that the railroad pools do not want feeding and watering cars, he would have been correct; and the "milk in the cocoanut" is right here. These pools are all interested in the feeding stations and stock-yards, whose revenues are lessened by the use of feeding cars.

Again, the railroad companies receive just as much in freight charges for transporting stock in common stock cars, which cause so much loss and damage to shippers by shrinkage in weight, and death in transit, as they would be entitled to for hauling the same number of cattle in improved cars. The railroad companies receive also enormous profits from their feeding yards, hence what matters it to them how much shippers may lose by their defective methods of transportation; what do railroad companies care for the terrible sufferings of the helpless dumb beasts that arrive at market in maimed and feverish condition, many of them wholly unfit for human food? Yet they are slaughtered, their carcasses refrigerated, and the beef served up to innocent consumers, resulting in bowel complaints, blood poisoning, and disorders that follow its train. Consumers of beef want feeding and watering cars because they afford them sanitary protection, and lessen the suffering of the helpless animals. Shippers want feeding and watering cars because they avoid the risks incident to unloading and reloading at feeding yards, they reduce shrinkage to a minimum, and thereby largely increase their profits. The margins in the cattle business have become so reduced that shippers can no longer endure unnecessary losses in transit. Reliable statistics were produced at the St. Louis and Denver conventions, showing that about six millions head of beef cattle are annually shipped to market in the United States, on which the average shrinkage in transit is $3 per head, aggregating $18,000,000 absolutely wasted.

With the foregoing points in view, it will be unnecessary to say anything further in commendation of this perfect arrangement for the safe transportation of cattle, by which this company is fulfilling its humane mission.

The Company's offices are located at 194 Washington street, Boston, Chicago, Kansas City, and Washington, D. C.

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SCIENCE AND EXPERIMENTS.

BY THE SECRETARY.

DURING the year there has probably been more work experimentally and scientifically performed in our state than ever before in an equal period. We may safely say, this is an age of "applied science." We are not content with abstract science. We have not full confidence in the dicta of mere scientists. We fear, in fact we know, there are agencies in nature that have not yet been fully measured by the devotees of science, that investigation must be pressed more thoroughly into all departments of agriculture before we learn the capacity of an acre of soil, a ton of hay or grain, the effects of feed, of cold and warmth on animal productiveness, or the utility of special combinations of chemicals and their adaptation to the varied soils which the farmer tills. We are making progress year by year, and one object of this report is to give annual records of the facts revealed, and by them measure our progress in the great farming interests of our state.

FERTILIZERS CONSIDERED.

Since our last report, we have caused to be made analytical examinations of nearly every special fertilizer used in the state. This work has been done, to some extent, at the College of Agriculture, but often by special manipulation by other parties with whom favorable terms could be made. In addition to this work, we have appropriated the results given by experimental stations. From these sources we are able to present a precise and nearly complete statement of the amount of chemical plant food in the fertilizers most in use. Knowing the market value of nitrogen,

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phosphoric acid, potash, and whatever enters into the preparations, we can readily compute the trade value, and approximately the agricultural value, of the fertilizers that are reported. There is, however, a deficiency existing, unless we can have the means of learning from the analyses the source from which these elements are obtained, for nitrogen is more effectual and therefore more valuable when derived from one substance than it is if obtained from a different one. The same is true of potash and of phosphoric acid.

This may be determined at experimental stations, where ample facilities are afforded. These stations determine annually the ruling prices of these elements, and by concert of action base their computations upon them for the time, until there is a necessity for a revision. The scale of trade values, for the past year, of the fertilizing ingredients as raw materials, appears in the accompanying schedule: —

	Cts. per lb.
NITROGEN.	
In ammonia salts	18½
Nitrates	10½
Organic nitrogen in dried and fine ground fish	17
Guanos dried and fine ground blood and meat	17
Cotton seed, linseed meal, and in castor, from all	17
Fine ground bone	17
Fine medium bone	15
Medium bone	13
Coarse medium bone	11
Coarse bone, horn shavings, hair and fish scraps	9
PHOSPHORIC ACID.	
Soluble in water	8
Soluble in ammonium citrate	7½
Insoluble in dry ground fish	7
In fine bone	7
In fine medium bone	5
In medium bone	5
In coarse medium bone	4
In coarse bone	3
In fine ground rock phosphate	2

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POTASH.

	Cts. per lb.
As high grade sulphate	5½
Kainite	4½
Muriate	4¼

Now, if the package is marked so that the source of the various ingredients is known, the value can easily be determined by the above table. Thus, suppose that there was 3 per cent nitrogen, and that it is derived from medium bone, then one ton would contain sixty pounds of nitrogen, at 13 cents per pound, or $7.80. If there is 4 per cent of potash derived from muriate, then there would be eighty pounds, at 4½ cents per pound, or $3.40. If there is 8 per cent of phosphoric acid derived from coarse bone, then there would be 160 pounds, at 3 cents per pound, or $4.80, thus making the ton worth $16.

The farmer, especially the doubting one, may say, "This is not satisfactory, nor reliable, for the reason that I know nothing about chemistry, and can't tell if I am paying too much for the income I shall reap from its use." But any farmer can learn to make the computation of the amount of any ingredient in a fertilizer when the per cent is given on the label accompanying the article. Then, having ascertained that, he may determine the value in a ton of each and every element. He may not be able to learn from the manufacturer's label the source of each element, and cannot, therefore, obtain the exact value, but let him take a medium value, like 17 cents for nitrogen, 7 or 8 for phosphoric acid, and 4 or 5 for potash, and he will come sufficiently near to answer his purpose. It is too complicated for him to go more definitely into the work, until state laws require a statement of the sources on the labels.

To be sure, the farmer will find that the same result will not follow the use of a fertilizer on different soils. But this is not a fault in the article applied. He will learn in time by experience that some fields do not need potash or some other element, and govern himself accordingly.

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	Nitrogen.			Phosphoric Acid.										Potash.		
				Soluble.		Reverted.		Insoluble.		Total.		Available.				
	Water.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.	Valuation per ton.
Belknap's ground bone	5.00	4.52	4.41	0.00	0.0	2.67	0.0	19.44	0.0	22.11	24.0	2.67	0.0	0.00	0.0	36.09
Bowker's fine bone	10.90	3.47	2.50	0.23	0.0	2.51	0.0	17.51	0.0	20.25	20.0	2.74	0.0	0.00	0.0	32.69
L. B. Darling's fine bone	5.00	4.05	3.50	0.41	0.0	8.07	0.0	17.05	0.0	26.53	22.0	8.48	0.0	0.00	0.0	43.58
Williams, Clark & Co.'s fish and potash	9.63	3.00	3.50	0.54	0.0	2.91	0.0	4.06	0.0	7.51	3.0	3.45	0.0	4.30	3.0	23.34
Quinnipiac fish and potash, crossed fishes brand	26.45	3.65	3.25	1.75	0.0	2.93	0.0	0.32	0.0	4.98	5.0	4.66	3.0	3.28	3.0	25.90
Bowker's fish and potash	8.30	2.64	2.25	3.08	0.0	2.86	0.0	4.44	0.0	10.38	3.0	5.94	0.0	4.98	4.0	27.85
Church's fish potash	29.98	4.26	4.00	0.96	1.0	3.92	1.0	0.53	2.0	5.41	5.0	4.88	2.0	4.30	3.0	27.48
Bowker's dry fish	11.90	8.05	8.00	0.70	0.0	2.63	0.0	4.51	0.0	7.84	7.0	3.33	0.0	0.00	0.0	38.51
Quinnipiac dry fish	10.88	8.67	7.00	0.51	0.0	2.82	0.0	3.52	2.0	6.85	6.0	3.83	4.0	0.00	0.0	39.81
L. L. Crocker's hop and potato fertilizer	12.10	2.99	2.00	5.94	6.0	2.10	2.0	1.01	1.0	9.05	9.0	8.04	8.0	5.06	6.0	29.92
" phosphate	14.48	3.07	2.90	7.29	6.0	1.14	2.0	1.00	1.0	9.43	9.0	8.43	8.0	1.60	1.0	29.11
U. S. and Can. Co-op. Fer. Co.'s phosphate	10.63	2.05	1.25	6.32	0.0	2.13	0.0	4.09	0.0	12.54	0.0	8.45	8.0	3.20	4.0	30.08
Whittemore Bros.' complete	21.05	2.68	0.00	6.08	0.0	4.31	0.0	1.68	0.0	12.07	0.0	10.39	0.0	3.20	0.0	31.55
Dole's No. 203 fertilizer	11.13	3.27	3.00	2.62	0.0	3.08	0.0	5.13	2.0	10.83	10.0	5.70	8.0	3.98	3.0	28.90
Soluble Pacific guano	14.03	2.17	2.00	6.90	6.5	1.83	2.0	3.30	2.0	12.03	12.0	8.73	8.0	2.04	2.0	27.53
Darling's animal fertilizer	14.93	4.36	3.33	0.20	0.0	4.40	0.0	5.92	0.0	10.52	10.0	4.60	0.0	4.91	4.0	32.01
Stockbridge corn manure	10.95	4.23	4.00	6.14	5.0	1.50	0.0	2.52	0.0	10.16	0.0	7.64	7.0	4 94	4.0	34.90
" potato manure	10.08	4.66	3.25	5.76	0.0	2.18	0.0	2.12	0.0	10.06	8.0	7.94	7.0	4.56	5.0	36.22
Bradley's XL superphosphate	13.53	3.35	2.50	8.64	7.0	1.91	2.0	1.67	2.0	12.22	11.0	10.55	9.0	2.46	2.0	35.58
Bay State b. superphosphate	22.43	2.99	2.71	9.08	9.2	0.15	0.0	1.01	3.0	10.24	12.2	9.23	0.0	0.84	0.0	28.86
E. Frank Coe's phosphate	21.48	3.02	2.64	6.78	0.0	0.24	0.0	1.30	1.28	8.32	12.2	7.02	11.0	0.82	0.0	25.19
Bradley's original Coe	12.95	3.07	2.05	8.23	7.0	1.90	2.0	2.41	2.0	12.54	11.0	10.13	9.0	0.30	0.0	31.09
Quinnipiac phosphate	17.60	3.16	2.50	8.06	0.0	2.18	0.0	1.89	1.0	12.13	9.0	10.14	8.0	2.07	2.0	32.65
H. J. Baker & Bros.' A. A. am. bone superphosphate	9.78	3.60	2.50	10.46	0.0	0.83	0.0	0.34	0.0	11.63	0.0	11.29	10.0	2.14	2.0	35.21

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H. J. Baker & Bros.' complete potato manure	8.75	3.78	3.30	6.17	0.0	1.19	0.0	0.24	0.0	7.60	5.7	7.36	0.0	8.20	10.0	33.77
Mitchell's superphosphate	15.53	1.43	1.65	6.33	8.0	3.30	0.0	1.35	2.0	10.98	10.0	9.30	0.0	3.84	3.0	26.17
Bowker's hill and drill	16.28	2.77	2.50	7.90	8.0	2.63	1.0	1.81	2.0	13.34	11.0	10.53	9.0	1.41	2.0	31.90
Mapes's pota o fertilizer	12.38	3.63	4.50	5.05	0.0	3.24	0.0	3.76	0.0	12.05	0.0	8.29	8.0	7.62	6.0	39.14
Mapes's complete manure	16.00	4.58	4.90	1.63	0.0	7.89	0.0	4.88	0.0	14.40	10.0	9.52	0.0	3.54	3.0	38.99
Williams, Clark & Co.'s am. bone superphos	13.03	3.04	1.65	9.76	6.0	1.86	3.0	1.01	1.0	12.63	10.0	11.62	9.0	2.51	2.0	35.94
Russell Coe's Co., am. bone superphosphate	15.05	2.28	1.65	4.86	0.0	1.78	0.0	4.68	1.0	11.31	10.0	6.64	9.0	1.66	1.5	24.97
Russell Coe's Co., soluble superphosphate	10.05	0.71	0.00	4.80	0.0	6.24	0.0	6.20	2.0	17.24	12.0	11.04	12.0	1.58	1.5	27.48
Standard phosphate	5.58	2.80	2.50	2.62	0.0	5.96	0.0	3.10	2.0	11.68	11.0	8.58	9.0	2.41	2.9	28.87
Darling's animal fertilizer	9.46	2.80	4.00	0.45	0.0	5.15	0.0	9.74	0.0	15.34	10.0	5.60	0.0	4.10	5.0	32.41

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PERFORMED FOR THE STATE GRANGE.

A committee of the Patrons of Husbandry, composed of Nahum J. Bachelder, Fred T. Stanton, and T. S. Pulsifer, caused experiments with fertilizers to be made, and the results given, not in bushels nor pounds, as will be seen, but the return was made in cash income for one dollar invested. Some of the profits are immense if correctly represented. See $3.90 as the result of a single dollar in corn, or $4.71 on the potato crop. Mr. Weeks ought to be a rich man. In case no figures are given, parties omitted the use of the specified fertilizer. No account is made of labor. If equal labor was given each lot, the test would be a fair one: —

Experiment By.	Crop.	Bowker's Hill and Drill.	Pacific Guano.	Bradley's.	Bay State.	Stockbridge.	Buffalo.	Standard.	Corn, Chemicals, Muriate of Potash, and Sulphate of Ammonia in equal parts.	Ground Bone and Ashes.
George R. Drake, Pittsfield	Corn.	$1.15	$1.14	$1.53	$1.75	$1.17	$1.15	$1.15	.....	.....
S. D. Weeks, Sanbornton.	"	.....	.....	.....	3.90	.....	.....	.....	.....	.....
Jesse Gould, South Weare.	"	.57	.34	.63	.63	.....	.57	.....	.....	$0.08
Wm. T. Saunders, Epsom	"	3.08	1.56	2.08	.....	2.34	4.62	.....	.....	.....
Isaac Smith, Hillsborough.	"	1.08	1.10	1.23	.75	.....	1.25	.....	.....	.....
James Hayes, Dover.....	"	.90	.52	1.12	.....	.97	1.05	.....	.....	.....
A. P. Chamberlain, Dunbarton.....	"	.....	.....	3.75	.....	.....	4.86	.....	.....	1.08
E. G. Cate, Boscawen	"	.18	.54	.24	.66	....	.....	.30	.....	.36
Fred T. Stanton, Strafford	"	.....	.....	.....	.....	.....	.....	.....	$4.23	.....
J. W. Farr, Littleton.....	Potatoes.	.....	.....	.96	2.55	1.92	1.02	.....	.....	...
S. D. Weeks, Sanbornton.	"	.....	.....	...	4.71	.....	.....	.....	.....	.....
Lemuel Martindale, Cornish	"	2.46	.....	1.53	1.12	.....	.....	.....	.....	.39
Baxter Gay, New London.	"	2.87	3.62	.....	...	.....	.....	.....	.....	.50

ASHES.

	Leached.		Unleached.	
	Per hundred weight.	Pounds per bushel.	Per hundred weight.	Pounds per bushel.
Potash	1.19	0.66	6.51	2.60
Phosphoric acid	1.72	.95	1.98	2.80
Lime	31.00	17.05	37.75	15.10
Value per one hundred pounds	18 cents	.....	43.5 cts.	.....
Value per bushel	12 cents	.....	20 cts.	.....

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Unleached ashes will average not far from twenty-five cents a bushel on the ground, and leached ashes may be called only about one half of that value — that is, leaching removes nearly one half their manurial value.

GEORGE R. DRAKE'S EXPERIMENT.

The soil was a dry loam. The subsoil was gravel. Gypsum was dusted over the soaked corn at planting, except in plot 11. The above tests were made in the middle of a three-and-a-half-acre field of inverted sod. No fertilizer was applied except as above specified. The corn was planted May 16, less than one day's hand-hoeing was done per acre, and the corn was weighed at harvesting on November 3.

Mr. Drake is a careful experimenter, but he ought, we think, to have reckoned the cost of preparing his night-soil, or he gives it undue credit.

No.	Kind of Fertilizer.	Quantity applied in the hill.	Cost of fertilizer per acre.	Yield of corn per acre in pounds.	Excess over the yield where no fertilizer was applied.
1.	Standard	1 oz.	$ 5.00	2,713	763
2.	Night-soil compost	1 handful	.....	2,338	388
3	Stockbridge, for corn	1 oz.	6.25	2,925	975
4.	Pacific guano	1 oz.	5.00	2,675	725
5.	Bone dust and ashes, Nichols's formula	1 oz. bone dust.	10.00	2,025	75
6.	Bay State	1 oz.	5.00	3,090	1,140
7.	Buffalo	1 oz.	5.00	2,700	750
8.	Bradley's XL	1 oz.	5.00	2,971	1,021
9.	Bowker's hill and drill.	1 oz.	5.00	2,725	775
10.	Corn "rolled" in gypsum	.....	.15	1,950	.....
11.	Nothing	.....	.....	1,861	.....

It would seem proper that the difference in stover should be regarded.

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FEEDING-STUFFS ANALYZED.

Elements.	Corn Meal.	Hominy Meal.	Rye Bran.	New-Process Linseed.	Gluten Meal.
Water	15.03	9.22	12.31	12.70	8.86
Ash	1.45	3.12	4.35	5.14	1.01
Protein	9.09	11.20	16.08	33.25	29.12
Fiber	1.85	4.02	4.09	8.08	.86
Nitrogen-free ext.	68.86	62.88	60.15	37.19	53.91
Fat	3.72	9.56	3.04	3.64	6.21

CLOVER HAY, — 1,000 PARTS SUBSTANCE.

	Red Clover.	White Clover.	Alfalfa.
Water	160.0	160.0	160.0
Ash	56.5	60.3	60.0
Potash	19.5	10.6	15.2
Soda	.9	4.7	.7
Magnesia	6.9	6.0	3.5
Lime	19.2	19.4	28.8
Phosphoric acid	5.6	8.5	5.1
Sulphuric acid	1.7	5.3	3.7
Silica	1.5	2.7	1.2
Chlorine	2.1	1.9	1.1
Sulphur	2.1	2.7	2.6

It is found that there is left of roots and stubble in the soil ten inches deep, after the growth of the following-named crops, as follows: —

COMPOSITION OF ROOTS AND STUBBLE — POUNDS PER ACRE.

	Red Clover.	Rye.	Wheat.
Dry vegetable matter	6,580	3,400	2,240
Nitrogen	180	62	22
Lime	246	69	72
Magnesia	46	14	10
Potash	77	30	17
Soda	19	40	11
Sulphuric acid	24	12	7
Phosphoric acid	71	24	11

ANALYSIS OF BRANS.

The following shows the difference between the old and the new process of milling, as shown at the Wisconsin Experiment Station: —

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Water-free.	Roller Process.	Old Process.
Ash	7.11	5.59
Protein	17.64	14.79
Woody fiber	8.46	9.23
Nitrogen-free extract	61.54	66.12
Fat	5.25	4.27

It will be seen the roller process gives more of the valuable elements, as fat and albuminoids, than the old process. The old process has more of what are called carbohydrates, or the nitrogen-free extracts, as starch, sugar, etc. These are not as expensive as the flesh-making elements, but both are necessary to animal growth.

In Chicago, there is made a feed called "stock food cake." It claims to possess something like linseed and cotton-seed meal, combined with sugar, oil, and albumen. The combination is not made public, but it is said it contains no linseed. It probably includes bean meal, cotton-seed hulls, etc. The chemist at the station at Madison, Wis., compares it with new-process oil meal as follows: —

	Stock Food.	Oil Meal.
Water	12.30	10.51
Ash	6.67	6.06
Protein	33.94	33.45
Woody fiber	6.85	8.37
Nitrogen-free extract	34.53	38.78
Fat	5.71	2.83

It will be seen that the two articles are of nearly the same value. A mixture of bean flour or meal with cotton-seed meal in equal parts will give an analysis very near that of the "food." The addition of a few elements in such quantities may be the only difference; for example: —

	Bean Meal.	Cotton Seed.	Mixture.
Water	14.50	7.83	11.15
Ash	3.10	7.20	5.15
Protein	25.50	42.45	33.94
Woody fiber	9.40	5.67	7.54
Nitrogen-free extract	45.90	23.49	34.70
Fat	1.60	13.36	7.48

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A BIG MILK RECORD.

Charles H. Hayes, of Portsmouth, is the leading Ayrshire breeder in the state, and is not excelled in milk-producers by any reported herd. He has just published the following record: —

NAME.	Herd Book No.	Age Jan. 1, 1886. Yrs.	Ms.	Last Calved.	Due to Calve, 1887.	Days Dry, 1886.	Milk — lbs. 1886.	Greatest Yield 365 Consecutive Days.	Remarks.
Queen Mary	6578	8	10	Nov. 26, '85	Dead	27	9,665¼	11,154¼	Died Nov. 30, 1886, of milk fever.
Lady Teazle	6579	7	7	June 28, '86	May	50	8,107½	9,267½	
Chinchilla	6589	4	4	Feb. 4, '86	March	36	7,972¼	7,972¼	
Cherry of Portsmouth	6585	4	6	July 27, '86	July	40	7,282	7,282	
Crocus	3400	12	1	July 17, '86	May	25	7,082	7,082	
Maid of Athens	4542	8	9	June 18, '86	June	7	6,905½	6,905½	
Claret	6586	4	6	May 9, '86	May	100	6,517	6,961½	
Creole	6593	3	6	June 23, '86	January	101	6,608¾	6,889	
Crowfoot	6597	3	9	March 7, '86	February	130	6,092¼	6,203	
Eva's Girl	7309	3	7	Sept. 2, '86	August	44	5,528⅞	5,558⅛	
Fashion	6587	4	6	Aug. 10, '84	Farrow	Not dry.	5,412	5,744¼	
Clio	6583	4	7	Aug. 22, '86	August	33	5,369¼	5,369½	
Diana		3	5	Dec. 22, '86	Not served	112	5,207½	6,053½	
Maid of Arles	8395	2	7	June 28, '86	June	31	4,959	4,959	
Frost	8397	2	3	March 3, '86	June	First calf.	4,711½	4,711½	First calf.
Mint	6592	3	7	May 11, '86	August	100	3,503⅛	3,503½	
Flossie of Portsmouth	6594	3	6	March 11, '86	February	120	3,121	3,121	
Dillias	8394	2	7	May 17, '86	April	First calf.	2,887	2,887	First calf.
Total						956	106,962	111,625	
Average						53 1-9	5,942½	6,201 7-18	

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FERTILIZER EXPERIMENTS.

[From the Manchester Union.]

HON. J. O. ADAMS, secretary of the State Board of Agriculture, inaugurated a series of experiments with fertilizers last season, and furnishes *The Union* with the results. The experiments were conducted by Mr. W. O. Smith, on the secretary's farm, and are reported as follows: —

CORN.

Soil, light, sandy loam, cropped annually with corn, rye, and clover, without animal manure; corn, small 8-rowed Canada. Experiments with different fertilizers, the value of $16 per acre,— no allowance made for surplus unused, except in case of manure, when $32 worth was applied, and one half charged to future crops, — showed the following results per acre. The plowing, planting, and harvesting cost $8 per acre, the husking and shelling at ten cents for each shelled bushel: —

Lot.	Fertilizer.	Corn. bu.	Stover. lbs.
1.	No dressing	8.3	1,160
2.	Jefferd's	18.0	1,500
3.	Muriate potash	26.0	2,060
4.	Cow manure	26.3	1,800
5.	Buffalo	28.6	2,720
6.	Dissolved bone	32.9	2,450
7.	Dole's new corn senna	34.6	2,720
8.	Bradley's sea fowl	34.6	2,800
9.	Chemicals	38.9	3,280
10.	Bradley's XL	40.3	2,860
11.	Sal ammonia	43.5	1,880
12.	Cotton-seed meal	55.9	2,440

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COST AND VALUE PER ACRE.

Lots.	Cost.	Corn Value.	Stover Value.	Total.
1	$8.83	$5.81	$3.87	$9.68
2	25.80	12.60	5.00	17.60
3	26.60	18.20	6.87	25.07
4	26.63	18.41	6.00	24.41
5	26.86	20.02	9.07	29.09
6	27.29	23.03	8.17	31.20
7	27.46	24.22	9.07	33.29
8	27.46	24.22	9.33	33.55
9	27.89	27.23	10.93	38.16
10	28.03	28.21	9.53	37.74
11	28.35	30.45	6.26	36.71
12	29.59	39.13	8.13	47.26

On this land it will be seen that, poor as the soil is, we can grow corn at a profit without manure, but we will not claim to continue it as a paying product. This is on our poorest land, having no manure for five or six years. On this soil, Jefferd's, a new article manufactured at Worcester, the loss was $8.20 per acre. It may pay on other soils. Muriate of potash showed a loss of $1.53. This land needs potash, but evidently it should be accompanied by ammonia or phosphoric acid in small quantities. Cow manure, made from ensilage, cotton-seed meal, corn meal, and shorts, shows a loss of $2.22, why I cannot tell.

The Buffalo brought a profit of $2.13. The Buffalo for potatoes, used on corn, made better response a year before than the general brands, but it was not tried by the side of others this year. Dissolved bone came in with a profit of $3.93. Had potash been put with it, the product ought to have been much larger. Dole's fertilizer had a stigma attached to its name from a predecessor, known as the "Common Sense," which was a farce. This is Dole's new Common Sense. The profit on this was $5.83 per acre. Bradley's Sea Fowl returned a surplus of $6.09 over cost. Chemicals came in with $10.29 to show. We believe in fine ground chemicals, applied as the farmer on careful tests finds the soil requires. We do not claim to have made the best combination.

Bradley XL, as usual, does well on this farm. Early in the season his preparation made the best show. The net income was $9.71.

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Sulphate of ammonia gave solid corn, but not heavy stover. The profit was $8.36.

Cotton-seed meal, as in former tests, excels all. The income was $17.67.

We have called the corn dry and recently shelled seventy cents a bushel, the price at which this variety will sell near by. We have sold for that at the ton. For the dried stover we have allowed one third the price of good hay. It is worth more than that when properly fed to young stock or milch cows.

POTATO EXPERIMENTS.

On the same farm by the same party, experiments were made on potatoes. This was on old ground that had been fairly manured and used for early crops for five years. It is very dry, but the drought had but little injurious effect on the crop this year.

The expense, not allowing for taxes or use of land, is put down as follows: Preparing land, $3.50 per acre; seed, $5; planting, $3.50; fertilizer, $25; cultivating and hoeing, $5.50; digging and housing, $10; total, $52.50. We put the potatoes at fifty cents for good ones and ten cents for small ones—a low price:—

	Good. bu.	Small. bu.	Value.
1. Bradley's XL	250	41⅔	$129.17
2. Sal am. and potash with muck	223⅓	45⅞	116.94
3. Bradley's potato	225	52⅔	117.77
4. Sea fowl	216⅔	33⅓	111.73
5. Clean muck	200	50	105.00
6. Nothing	191⅔	68½	102.68
7. Dissolved bone	185⅓	52½	97.92
8. Chemicals	177½	41⅔	92.92
9. Cotton seed and ammonia	175	41⅔	91.67
10. Sulphate of ammonia	166⅔	37½	87.09
11. Potash and sal ammonia	158⅔	45⅞	83.92
12. Potash and dissolved bone	154⅓	33⅓	80.44
13. Potash	108⅓	50	59.17

"No dressing" gave $75.18 profit. But this was due to previous cultivation, and we were surprised at the result. The

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income above costs for the lot was, per acre, as follows: No. 1, Bradley's XL, gave $76.67, or a trifle for the fertilizer, as no dressing gave $75.18. Sulphate of ammonia, $64.44; Bradley's potato, $65.67; sea fowl, $59.23; clear muck, reckoning the same value as phosphate, $52.50; dissolved bone, $45.42; chemicals, $40.42; cotton seed and ammonia, $39.17; sulphate of ammonia, $31.42; potash and sulphate of ammonia, $31.22; potash and dissolved bone, $27.94; potash, $6.67. The section on which the potash was used was the poorest, while that on which nothing was applied was the best.

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THISTLES.

BY GRANT ALLEN.

[From Longman's English Magazine.]

THERE is no weed weedier or more ubiquitous than the common thistle. In paradise, it is true, if we may trust John Milton and the Sunday-school books,— wise, as usual, beyond what is written,— there were no thorns or thistles, the creation and introduction of the noxious tribe upon this once innocent and thornless earth being a direct consequence of the fall of man, and a stern retribution for Adam's delinquency. But since then the thistle has managed so to diffuse itself over the habitable globe that there hardly now remains a spot on earth without its own local representative of that ever-intrusive and conquering genus. Wherever civilized man goes, there the thistle accompanies him as a matter of course in his various wanderings. It adapts itself to all earthly environments. Close up to the Arctic Circle you find it defying the indigenous reindeer with its prickly wings; under an equatorial sky you may observe it accommodating itself most complacently with a sardonic smile to tropical existence, and battling with the prickly cactuses and the thorny acacias, to the manor born, for its fair share of the dry and arid uplands. Even nettles are nowhere in competition with it. In spite of its valuable and irritating sting, the nettle has not the plasticity and adaptability of constitution that mark the stout and sturdy thistle tribe. Garnered and harvested yearly with the farmer's corn, its seeds have been gratuitously distributed by its enemy, man, in all climates, and when once it gains the slightest foothold, its winged down

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enables it to diffuse itself *ad infinitum* through the virgin soil of yet unconquered and unthistly continents. A field of thistles in England itself is a beautiful sight for the enthusiastic botanist (who has usually a low opinion of the agricultural interest); but in the fresh and fallow earth of New Zealand they attain a yet more prodigious and portentous stature, that might well strike awe and dismay into the stout heart of a Berkshire farmer.

The fact is, the thistle is one of those bellicose plants which specially lay themselves out, in the struggle for existence, for the occupation of soils where they are compelled to defend their leaves and stems from the constant attacks of the larger herbivores. On open plains and wide steppes, much browsed over in the wild state by deer or buffalo, and in the degenerate civilized condition by more prosaic cows and donkeys, one may always note that only the prickliest and most defensive plants have any chance of gaining a livelihood. Gorse and blackthorn form the central core of the little bushy clumps on our English commons, grown over thickly with bramble and dog-rose, or interspersed every here and there with occasional taller masses of may and holly. Nay, at times even naturally undefended species assume a protective armor under such special circumstances, as in the case of the pretty little pink rest-harrow, which grows close to the ground, with soft stems and leaves where unmolested by cattle, but quickly develops an erect and stiffly thorny variety when invaded by troops of cows or horses. In that case the unarmed specimens get eaten down in a short time by the browsing cattle, and only those which happen to possess any slight tendency in a prickly direction are left to occupy the stubborn soil and produce feed for the next generation. It is this unconscious selective action of the larger herbivores which has at last produced the general prickliness of all the plants that naturally frequent rich and open lowland pastures.

There are differences, however, between prickles and prickles. Some plants are positively aggressive, like the stinging-nettle; others are merely and strictly defensive, like the common thistle, whose proud motto, as everybody well knows, is "*Nemo me impune lacessit.*" In the very doubtful Latinity of the Licensed Victualers it goes in strictly for "*Defensio non provocatio*";

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whereas the nettle, it need hardly be said, is often most distinctly provoking, and even goes out of its way to annoy a neighbor. This distinction I take to depend upon a difference in the acquired habits of the two races. The nettle is almost entirely a product of urban civilization. It hangs about the streets and outhouses of small villages, the neighborhood of farm-yards, and the immediate surroundings of rural man. It lives in constant expectation, as it were, of being browsed upon by donkeys, or trampled under foot by cattle, or picked by children, or stubbed up, root and all, by the ruthless farmer; hence its temper has become permanently soured, and it has at last developed a restless, feverish, wasp-like habit of stinging everybody who comes within arm's length of it. It is necessary to the safety of the nettle, in fact, that it should give you warning of its presence at once, and induce you to keep well away from it under pain of a serious and lasting smart. Our common English nettle, which grows everywhere along roadsides and waste places, is bad enough in this respect, but the smaller nettle — a foreign importation of more strictly civilized and urban habits, never found far from human habitations — is still crueler and more poisonous, while the South European Roman nettle, accustomed for innumerable generations to the fierce struggle against Italian civilization, has developed an advanced and excruciating sting, which beats the puny efforts of our own species into complete insignificance, as the virus of the hornet beats the virus of the hive-bee.

On the other hand, the thistle family are far more truly rural and agricultural in their habits, being denizens of the open fields and meadows, less dependent than the nettles upon richness of soil, and readily accommodating themselves to all vacant situations, hence they have only felt the need of arming themselves in a rough-and-ready prickly fashion against the probable assaults of their natural enemies. They have forged darts, but have not learned to poison them. Their prickly leaves and wings are amply sufficient for defence, without the necessity for developing a virulent juice to be injected into the very veins of their savage aggressors. Natural selection can never push any special line of evolution further than is imperatively called for by the wants and circumstances of the particular species. It always necessarily

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leaves off just at the point where the protection afforded is fully sufficient to guard the kind from the possibility of extinction. The thistles have found in actual practice that prickles alone are quite enough to secure their boasted immunity from extraneous attacks. The nettles have practically discovered for themselves that without stings they would soon be landed in the final limbo of utter nonenity.

Circumstances have still preserved for us a very tolerable series of the successive stages whereby our existing thistles have gradually acquired their present prickly and repellent characteristics. In the good old days, while evolution was still fighting hard for public recognition, it used to be urged by the uninstructed outsider that we never found any "missing links." As a matter of fact, in ninety-nine cases out of a hundred the links are not and never were missing at all, and the practical difficulty is rather to establish any well-marked distinctions of kind than to discover long series of intermediate individuals. Just as the white man gradually merges into the negro by slow steps, when we cross Europe, Asia, and Africa, through Italians, Greeks, Levantines, Arabs, Egyptians, Nubians, Abyssinians, and true Soudanese, so the various kinds of thistles merge imperceptibly one into the other by innumerable varieties and natural hybrids. To be sure, there *are* such things as well-marked species in nature; but there are also groups which it is impossible anywhere to split up into good and distinctly different kinds. The brambles, the wild roses, the St. John's-worts, and the epilobes absolutely defy regular classification: the thistles, though perhaps a little more amenable to the subtile arts of the artificial species-maker, still constantly glide one into the other by strangely graduated intermediate forms. The great *crux* really lies in the problem of the existence of such natural gradations; for, according to the strict Darwinian principles, the better adapted and more specialized forms ought to crush out the intermediate types, and leave the species well demarkated one from the other by broad intervals. Probably the true explanation of the anomaly is to be found in the wide distribution and high adaptability of these dominant forms; they can accommodate themselves exactly to such an extraordinary variety and diversity of situations, that special

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intermediate types answer best in every intermediate soil or climate.

The most primitive and unarmed class of the thistle tribe is well represented by the saw-wort of our copses, a true thistly plant in all its general appearance and habits, but absolutely devoid of thorns or prickles. The leaves, indeed, are toothed and pointed, but the points never project into fierce spines, as in the more advanced kinds; and even the little scales that form a cup for the flower-head, though faintly stiff and sharp, are scarcely if at all defensive in character. The flower, of course, is usually the first part to be specially protected, because upon it depend the future seeds and the hope of coming generations of thistles. Just as instinct teaches female animals to fight fiercely and bravely for their young, so natural selection teaches menaced plants to arm themselves stoutly against the threatening depredators of their seeds and blossoms. The reason why the saw-wort and its unarmed South European allies have managed to do without the protective inventions of their more developed relations is no doubt because they live mostly in thickets and woody places, not much overrun by cattle or horses. Their neighbors in the open meadows and pastures have been compelled long since to adopt more military tactics in order to save themselves from premature extinction. Often, indeed, in a close-cropped paddock, you will find only two kinds of tall plant uneaten by the beasts — the meadow buttercup, preserved from harm by its acrid juices, and the creeping thistle, armed all round with its long rows of parallel prickles.

In the mountains of Wales and the north of England there is yet another kind of true thistle, classed as such by technical botanists (for the saw-wort is artificially relegated to a distinct genus), which is also destitute of prickles on the leaves, though it sometimes shows the first faint beginnings of a prickly tendency around the scaly flower-cup, and in the bristly teeth of its crinkled leaves. From this early stage in the evolution of thistledom we can trace the gradual steps in the defensive process, through thistles that grow with prickly leaves, and those in which the prickly margins begin to run a little down the stem, to those which have clad themselves from top to toe in a perfect mail of

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sharp spines, so that it becomes quite impossible to grasp them anywhere with the hand, and they can only be eradicated by the hoe or plow. It is a significant fact that the most persistent and troublesome of all these highly developed kinds, the creeping thistle, now universally diffused by man over the globe, is a special weed of cultivation, far most frequently found in tilled fields, and seldom disputing with the simpler forms the open moors, mountains, or pastures. It does not trust entirely, like others of its kind, to its floating seeds, blown about everywhere as they are by their light tag of thistle-down; but it creeps insidiously underground for many yards together, sending up from time to time its annual stems, and defying all the attemps of the agricultural interest to exterminate it bodily by violent measures. This is the common and familiar pale purplish thistle of our English corn-fields, and there can be little doubt that it has developed its curious underground habits by stress of constant human warfare, especially with the plowshare. Thus the very efforts we make at fighting Nature defeat themselves; if we persistently hoe down the stems and leaves of an obnoxious weed, the weed retaliates by sending out hidden subterranean suckers, and the last state of the agriculturist is worse than the first.

On the close-cropped chalk downs of our southern counties there is another curious form, the stemless thistle, which shows in another way the hard struggle of Nature to keep up appearances under the most difficult and apparently hopeless circumstances. Among the low sward of those chalky pastures, nibbled off incessantly as fast as it springs up by whole herds of Southdowns, no plant that normally raised its head an inch above the surface would have a chance of flowering without being eaten down at once by its ruthless enemies. So the local dwarf or stemless thistle has adopted a habit of expanding its very prickly leaves in a flat rosette or spreading tuft close to the ground, and bearing its blossoms on the level of the soil, pressed as tight as possible against the short turf beneath. The appearance of these three or four dwarfed and stunted but big flower-heads, bunched thickly together in the middle of their flat leaves, is most quaint and striking when once one's attention is called to their existence;

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yet so unobtrusive and unnoticeable is the entire plant that few people save regular botanists ever discover the very fact of its presence on the chalk downs. It is only one out of a large group of specialized chalk plants, all of which similarly creep close to the ground, while a few of them actually bury their own seeds in the soil by a corkscrew process, so as to escape the teeth of the all-devouring sheep. The power of producing a stem, however, is rather dormant than lost in the dwarf thistle, for under favorable circumstances and in deep soil it will raise its flowers eight or ten inches above the surrounding turf.

The question what particular plant ought to be identified with the stiff, heraldic Scotch thistle has long been debated, somewhat uselessly, it must be acknowledged, among botanists and antiquaries. For heraldry is not particular as to species and genus; it is amply satisfied with a general rough resemblance which would hardly suit the minute requirements of those microscopical observers who distinguish some forty kinds of native British blackberries. However, it has been amicably decided in the long run that the heraldic symbol of Scotland, that proud plant which no man injures unavenged, is not to be considered a thistle at all, but an onopord, a member of a neighboring though distinct genus, whose Greek name expressly marks it out as the favorite food of — how shall I put it with becoming dignity? — the domestic beast of Oriental monarchs. To what base uses may we come at last! The royal emblem of the north, as identified by Mr. Bentham and other profound authorities, is now at last settled to be nothing more nor less than the cottony donkey-thistle. North of the Tweed this identification should be mentioned, as French newspapers remark, under all reserves.

Almost all the thistles have purple florets, and purple, it may be safely assumed, is the primitive color of the whole thistle-head tribe. Some of them, indeed, fade off gradually into pink and white; but such reversion to a still earlier ancestral hue is everywhere common and easily brought about by stress of circumstances. The thistles in the lump are composites by family, and the apparent flower is really a flower-head, containing an immense number of small, bell-shaped, five-petaled florets, with the petals united at their base into a deep tube. The honey

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rises high in the throat within, and is sucked chiefly by bees and burnet-moths, who form the principal fertilizers of the entire group. Purple is the favorite color of these advanced flower-haunters, and it seems probable that all the purple blossoms in nature have been evolved by their constant and long-extended selective action. Nothing can be more interesting than to watch a great burly humble-bee (one of the large black sort) bustling about from flower-head to flower-head of the pretty, drooping, welted thistle on a bright summer's day, with his proboscis constantly extended in search of food, and unconsciously carrying the pollen-grains about his head and legs from the florets of one blossom to the sensitive surface of the next in order.

After the flowers have been duly fertilized, the thistle-seeds begin to swell, and the down around them to grow dry and feathery. This down, so familiar to all of us among the autumn fields, has doubtless played no small part in the dispersal of the thistles. It is to their floating seeds (or rather, to be strictly accurate, their fruits) that the entire family owe a great part of their existing vogue and unpopularity. In almost all the composites the tiny calyx grows out into much the same silky down on the ripe fruit, but in hardly any other case, save perhaps those of the dandelion and the common sow-thistle, does it form so light and airy a floating apparatus as in the true thistles. Wafted about on the wings of the wind, the thistle-down is blown easily hither and thither, alighting everywhere, far and near, and finding out fresh spots for itself to root and thrive on every side. Not only does this plan insure the proper dispersal of the seeds, however: it also provides for that most important agricultural need, the rotation of crops. Long before scientific farming had hit upon the now familiar rotatory principle, hundreds and hundreds of plants in the wild state had worked it out practically for themselves under stress of the potent modifying agency of natural selection. For thistles can no more grow on the same spot for an indefinite number of generations than corn or turnips can; they require to let the soil on which they live lie fallow for awhile from time to time, or be occupied by other and less exhausting crops. Hence it follows that in nature innumerable means exist for favoring or insuring the dispersal of seeds; or, to speak

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more correctly, only those plants in the long run succeed in surviving which happen to possess some such facility for constant rotation and occupation of fresh districts.

It is very interesting in this respect to compare the devices for the distribution of their seeds in some of the thistle's own nearest and best-known relations. The burdock, for example, is in flower and fruit almost a thistle, though it differs considerably from the thistles proper in its large, broad, heart-shaped foliage. But the burrs, or ripe flower-heads, instead of being surrounded, thistle-fashion, by a very defensive prickly involucre, have developed instead hooked points to their bracts, which catch at once at the wool of sheep, the legs of cattle, and the dresses or trousers of wayfaring humanity. In this way the entire head of seeds gets carried about from place to place, and rubbed off at last against a hedge or post (at least by its unwilling four-footed carriers), where it forms the nucleus of a fresh colony, and starts in life under excellent auspices, especially if dropped (as it is apt to be) in the immediate neighborhood of a well-manured farmyard. Hence the burdock has no further need for the down which it inherits, like all its tribe, from some remote common ancestor; it has substituted a new and more practically effective system of transport *en bloc*, for the old general composite mode of dispersal in single seeds by a feathery floating apparatus. Accordingly, the pappus, or ring of down, though it still exists as a sort of dying rudiment on each fruitlet of the burrs, is reduced greatly in size and expansion, and consists of a mere fringe of short, stiff hairs, useful perhaps in preventing flies from laying the eggs of their destructive grubs upon the swelling seeds. In the common knap-weeds, again, which wait for a high wind to shake out their seeds from the head, this dwarfing of the down has proceeded much further, so that at first sight a careless observer would never notice its existence at all: but if you look close at the ripe fruit with a small pocket lens, you will observe that it is topped by a ring of very minute, scaly bristles, occasionally mixed with a few longer and hairier ones, which are all that now remain of the once broad and feathery down. Among the true thistles, on the other hand, which trust entirely to the gentle summer breezes for dispersal, and which float away often for

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miles together, innumerable gradations of featheriness exist, some species having the down composed of long, straight, undivided hairs; while in others of a more advanced type it consists of regular feathered blades, barbed on either side with the most delicate beauty. Almost all our commonest and most troublesome English thistles belong to this last-named very feathery type, whose seeds are, of course, enabled to float about on the wind far more readily and to greater distances than the simple-haired varieties.

The thistle pedigree is a long and curious one. The group forms, apparently, the central and most primitive existing tribe of the composite family, and it bears in its own features the visible marks of a vast previous evolutionary history. Starting apparently from blossoms with five distinct and separate yellow petals, like the buttercups, the ancestors of thistlehood gradually progressed, as it seems, by insect selection, to a condition something like that of the harebell or the Canterbury bell, in which the petals have coalesced at their bases into a single large and united tube. Clustering together next into closely serried heads, like those of the scabious, the rampions, and the common blue sheepsbit, they endeavored to make up for the individual minuteness of their dwarfed flowers by the number and mass collected in a group on the summit of each stem. In this way they gradually assumed the distinctive crowded composite form, each floret consisting of a tubular five-lobed corolla, a calyx reduced to hairs or down, and single tiny seed-like fruit. Of this stage in the development of the family, the simpler and less specialized members of the thistle group, such as the unarmed saw-worts and the Alpine saussurea, are now the best surviving representatives. From some such early central form, the evolving composites split up and diversified themselves into all their astonishing and almost incredible existing variety. Some of them, varying but little in minor details from the parent stock, acquired prickly leaves and grew into the thistle kind, or developed hooked and sticky involucres, and were known as burdocks. Others producing at their edge a row of brilliantly colored and attractive florets, which serve the purpose of petals for the compound head, branched off into all the marvelous wealth of daisies, asters, sunflowers, mari-

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golds, dahlias, golden-rods, ox-eyes, and cinerarias. In yet others the whole mass of the florets, central as well as external, has assumed this ray-like or strap-like form; and to this group belong the dandelions, hawk-weeds, salsifies, lettuces, sow-thistles, chiccories, nippleworts, and cat's-ears. By far the most successful of all flowering plants, the composites have taken possession in one form or another of the whole world; and among the entire wealth of their extraordinary diversity there is no group more universally fortunate than the common thistle. What from the purely agricultural point of view we describe as a very persistent and almost ineradicable weed, from the higher biological point of view we should more properly regard as a dominant and admirably adapted species of plant. The one conception is merely narrow, practical, and human; the other is positive, philosophical, and universal.

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APICULTURE.

BY ALLEN PRINGLE, IN SCIENCE MONTHLY.

AMONG the recent industries of rapid growth in this country, bee-culture stands prominent. Of course, as a homely art, bee-keeping is no modern industry, being as old as history; but in its scientific developments it is of recent growth. In these times, when science is properly taking its place at the helm in all departments of human industry and activity, it is not strange that it is promptly assuming the guidance of bee-culture. This is a utilitarian as well as scientific age; and this is why bee-culture is being so rapidly developed, for its extraordinary growth is only in the ratio of its utility. Though known to commerce for twenty-five hundred years, hitherto it has been followed and known, in this country at least, principally as a local industry. But bee-culture, from the soundest economic considerations, ought undoubtedly to become a great national industry fostered and protected by the state. Apiculture is naturally a part of, and closely allied with, agriculture, inasmuch as the nectar gathered by the one is immediately derived from the same fields and forests that yield the abundant ingatherings of the other. Indeed, the bulk of the honey-crop of this country (which is, in round numbers, about 100,000,000 pounds annually) comes from the bee-keeping which is in connection, more or less, with farming.

But this is not the principal reason why bee-culture must take rank as an important national industry. The postulate is fully warranted by the following fact or facts: When the agriculturist takes his grain to market, he takes with it more or less of the *fer-*

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tility of his soil; when he takes his stock and dairy products to market, he does the same thing, only. perhaps, in a less degree. But, when he takes his honey to market, he does nothing of this kind, — he takes none of the fertile elements of his soil along with it. When the skilled apiarist, guided by science, so controls, directs, and manipulates his bees that they gather the rich nectar in tons from a given area, representing hundreds and even thousands of dollars, he impoverishes neither his own land nor that of his neighbor; he simply secures that which, if not gathered, "wastes its sweetness on the desert air." Likewise, when a country exports its surplus grain or stock, it also inevitably parts with more or less of its fundamental agricultural resources; but its exported honey-surplus represents no corresponding impoverishment of soil. It would therefore seem clear that, from economic considerations alone, bee-culture ought to and must take its place among the most useful and important national industries.

Ladies of high culture and refined tastes are engaged (and successfully, too) in bee-culture with all the enthusiasm which is naturally inspired by a congenial and ennobling pursuit; and this is the best proof of our contention as to its æsthetic status. Being withal a healthful occupation, bee-culture invitingly offers itself to those in delicate health and not strong enough for hard physical labor. In numerous instances such persons, by engaging in this pursuit, have not only procured liberal means of subsistence, but have also recovered lost health and strength. The capital required is comparatively small, while the average return for skilled exertion is large. Hardly any other legitimate business yields so large a return in dollars and cents for the amount invested and the work bestowed. True, bee-keeping has its formidable obstacles and serious drawbacks; but these, while sometimes troublesome to the scientific apiarist, are disastrous mostly to the unskillful or negligent, or the mere neophyte. And even though the cargo of industry sink, not much treasure in money or labor is carried to the bottom, while a very little capital added to the valuable lesson of failure soon sets the redoubtable amateur on his legs again.

The honey-bee, — which belongs to the general branch of the animal kingdom called *Articulates*, and to the class *Insecta*, and

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to the sub-class *Hexapoda*, and to the order *Hymenoptera*, and the family *Apidæ*, and genus *Apis*, and species *Apis mellifica*, — is one of the most intensely interesting studies in the whole domain of natural history. When the immortal Darwin had the scientific zeal and patience to study the apparently insignificant *earth-worm* for *forty* long years, leaving a field untouched for thirty years for the purpose of studying and observing the habits of these despised creatures, how comparatively easy and pleasant to study the honey-bee, which is so much more useful and beautiful! The fact that the honey-bee is so much more serviceable to man than many others of the lower creatures whose nature and habits are equally wonderful, as the ant, for instance, invests it with a double interest to us. Insects which are pests, no matter how marvelous in structure and habit, we cannot study with that intense pleasure and interest we can those that yield so much to our physical as well as mental gratification.

Of the species *Apis mellifica* there are many varieties, — the principal of which are the Ligurian or Italian bee; the German or black bee; the Syrian bee; the Cyprian bee; the yellow, Egyptian bee; the amiable, Carniolan bee, of Africa; the superbly beautiful Dalmatian bee; the Smyrnian bee, very popular in Austria; and the stingless bees of South America.

In this country (i. e., Canada and the United States) we have principally the German and Italian bees; but within the past five years the Syrian and Cyprian varieties have been extensively imported into this country by that distinguished and enterprising apiarist, D. A. Jones, of Beeton, Ontario. As the genus *Apis* is not indigenous to this continent, all now existing here have been introduced from the Eastern Hemisphere, — first, the black and Ligurian races, and latterly the Eastern varieties.

Each of the varieties now in this country (vying for "survival" as the "fittest") has its distinguishing characteristics. So far, however, the Italians seem to possess more good points and desirable qualities than any of the other races, and hence are the most numerous and popular among advanced apiarists. Their chief distinguishing qualities are superior amiability, industry, and what may be called patriotism, or indomitable energy in defending their homes against invaders, such as robber bees and

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the "bee-moth"— against both of which they are quite invincible. While different strains of this variety vary considerably in color, they are in general distinguished by three beautiful yellow bands across the abdomen. They also have longer tongues than the German bees, by which they are enabled to sip the nectar from places inaccessible to their less favored competitors. A. J. Cook, Entomological Professor in the Michigan Agricultural College, who has done very much to advance scientific bee-culture in the United States, says on this point: "The tongue of the black worker I have found, by repeated dissections and comparisons, made both by myself and by my pupils, is shorter than that of the Italian worker, and generally less hairy." In confirmation of this fact, established by Prof. Cook's dissections, I have frequently noticed my Italian bees, during a scarcity of honey from other sources, working upon the second bloom of the common red clover (not the *Trifolium pratense*, which the black bee can readily work upon), when the German bees were doing nothing on it, the flower tubes being too long for their tongues.

The black bees (or rather, German, for in point of fact they are not black in color, but a gray-black) have some desirable qualities, though they are now being rapidly superseded by the Italians. They produce nicer comb-honey than the Italians, or perhaps any other race. The proverbial whiteness and finish of their comb are due mostly to the extra *capping*.

For the Syrian races of bees Mr. Jones and some other leading apiarists claim some superior qualities. I am inclined to think the Syrian queens (Palestine strain), crossed with the Italian drones, will presently prove to be our very best bees — combining more good points than any other existing variety. Doubtless, however, the bee of the future will be greatly superior to anything we have at present. For purposes of experimentation in developing such, we have now in America several of the best varieties in existence under domestication. By judicious crossing, in accordance with the well-known laws of *variation* and *heredity*, such a result is quite certain. The vast improvement made in this way among our domestic animals within less than half a century fully warrants the conclusion that, in the evolution of things so palpable everywhere, we may in the case of our bees subsidize and utilize the same ever-acting law of progress.

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Following the Syrians, and genealogically closely allied to them, we have the Cyprians, though not yet widely diffused. They resemble the Italians, of which they are supposed to be the progenitors. The Cyprian bees have some good points, and one very bad *point*. They are famous for their fecundity, but equally *in*famous for their ferocity, being maliciously expert in using very pointed stings. This variety (unless in this inspiriting western atmosphere it acquires more amiability) is not likely to become popular, notwithstanding the marvelous fecundity of the queens. It may be possible, by crossing with some bee of good disposition, to mollify their bad tempers and retain their good qualities.

Of the remaining varieties of the honey-bee, and sub-varieties, including *hybrids*, little is practically known in this country, with the exception of one or two strains of the latter. The "hybrids," resulting from a cross between the Italian queen and the German drone, are well known in Canada and the United States, and, next to the pure Germans and Italians, are perhaps most numerous. These hybrids have excellent qualities: they make superb comb; are active and energetic; and, I have observed, stand the rigor of our Canadian winters much better than the pure Italians; but they are much less amiable.

A properly constituted colony of bees consists of three different kinds, viz.: an impregnated *queen* (the fully developed female); *drones* (the males); and *workers* (undeveloped females). The queen (absurdly called the "king-bee" from the time of Aristotle and even Virgil down to Huber) is the mother of the whole colony, and is capable of laying over three thousand eggs per day! During the height of the breeding-season in the honey-flow, she frequently lays from two to three thousand eggs per day for many consecutive days together. She remains prolific for from two to four years, and in some instances queens have been known to remain prolific upward of five years. Before the queen-bee of a colony becomes quite barren, and while she is still laying, if not removed by the apiarist, the workers themselves supersede her by killing her and rearing a young queen to take her place. Sometimes, however, the old, worn-out mother is permitted to remain in the hive while the young one is being reared, and ultimately dies of neglect and depression, or is assisted to "shuffle off" by her own unfilial

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progeny. The queen is reared from the same egg as the worker, but in a much larger cell, nearly perpendicular, and on different food, called "royal jelly," which has the effect of fully developing the sexual apparatus. The time from the egg to the perfect queen emerged from the cell is about sixteen days. In a few days after hatching, the young queen leaves the hive for her "bridal flight," during which, and on the wing, she meets the male bee or drone in copulation and becomes impregnated, when she returns to the hive to remain there until she leads out the first swarm, which she does when she finds young queens being reared in the hive — one of them designed to take her place. A *single* fertile queen in a colony is the normal condition of the household, and hence the old queen departs to make room for her successor. Second and third swarms are of course led out by the young queens. With the exception of sometimes attacking and destroying inchoate queens, the sole function of the queen is to deposit eggs and lead out the first swarm. After her impregnation she deposits both drone and worker eggs — either kind at pleasure. She is capable, however, as a virgin queen, of laying fertile drone, but not worker, eggs. This apparently anomalous fact (*parthenogenesis*) is now well established, not only in the case of the virgin queen-bee, but in that of several other insects. Sometimes *worker*-bees in queenless colonies lay fertile drone-eggs; but the queen is the only fully developed female in the colony.

The worker-bees, though "the bone and sinew" of the hive, are not blest with the queen's longevity. In active work, on the wing and off, during the honey-season, they naturally live but a few weeks — from one to two months — while those hatched late in the fall will live until spring, sometimes reaching the age of nine months and upward, which is the maximum longevity of the worker-bee. In passing from the egg to the perfect bee, the worker occupies twenty-one days. The young worker spends several days (from ten to fifteen) at home building comb, attending to the young brood, receiving and depositing the loads of the outside workers, and sundry other little duties, before it ventures to the fields to work. The duties of the older workers of the colony are to gather honey, pollen, and propolis, destroy and

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cast out the drones when necessary, and defend the colony from enemies without or within. They also, as already noticed, destroy old, unprolific queens and rear young ones to take their places, and sometimes lead out in swarming, as the queen does not always take the lead in swarming. And although very young bees are ordinarily very reluctant to leave the hive, I have seen such rush out under the swarming impulse so young that they couldn't fly more than a foot or two, if at all. They usually crawl back home again in apparent disgust with the outside world, and doubtless with more wisdom and less conceit.

The third and last rightful denizen of a perfect colony of bees is the unsophisticated, stingless, but much abused *drone* — the male bee. He is well named, however, being a very liberal feeder with excellent digestive organs for honey, and with no duties whatever within the hive further than the incidental one of contributing by the presence of his cumbrous corporation to the animal heat of the hive. As to his natural longevity, nobody from Virgil to Huber, Langstroth, Quinby, Newman, Cook, Jones, *et alii*, seems to know much about it. The matter not being invested with any importance, no investigator seems to have bothered his head much with it. So far as I could ever see, the drone seems to live and thrive admirably until he is either killed off by the workers, starved to death, or gallantly yields up his life in performing his sole function, which he invariably does in the performance of this function in the act of copulation. The drone, as Dr. Dzeirzon established, comes from an unimpregnated egg — the virgin queen, and sometimes even workers, being able to lay eggs which will produce drones. As a rule, drones are found in colonies whenever they are needed, or likely to be needed to impregnate the young queens, which is usually during the swarming season and honey-harvest. Though they are promptly ejected from strong colonies when not needed, and the honey-flow fails, they are tolerated in queenless colonies, and are sometimes wintered over. The drone is much larger than the worker, and his cell very protuberant, and in it he spends twenty-four days from the egg before he emerges.

As remarked at the outset, bee-culture made but little progress on scientific principles for thousands of years. It is only within

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the last half-century or so that it has, under the magical talisman of science, fairly leaped forward like every other pursuit. The first great achievement was the application of the centrifugal force in the construction of the honey-extractor, thus enabling us to get the honey in its purity out of the comb without injuring the latter, when it can be returned to the bees to be refilled. A German (Herr von Aruschka) accomplished this, and thereby gave a great impetus to bee-culture. Indeed, the invention of the *movable frame* and *honey-extractor* completely revolutionized the *modus operandi* of bee-keeping. As to who is really entitled to the credit of inventing the movable frame, there is some uncertainty and a conflict of claims. The truth seems to be that some three or four different persons are fairly entitled to credit — each, it would appear, having conceived and developed the idea, more or less independently of the others. Huber and Schmidt in Germany, Munn in England, M. de Beauvoys in France, and Langstroth in the United States, are all fairly though not equally entitled to credit, and each has placed progressive bee-culture under tribute. Mr. Langstroth, however, seems entitled to much more credit than any of the others, for his hive had more practical value than the whole of the others together. In carrying out the common principle, Langstroth was undoubtedly far ahead.

The next stride in advance was the invention of the manufacture of "comb-foundation," which was a great desideratum, as the honey-season in the temperate zone is comparatively short, and a new colony of bees supplied with the "comb-foundation" will do as much in two or three days as one alongside of it without the foundation will do in eight or ten days, as the writer has repeatedly proved. Foundation-comb is made by pressing sheets of pure beeswax between metal rollers or plates so constructed as to give to the wax the exact impressions of the cells in the basal wall of the natural comb. This saves the worker-bees just that much labor and time, and they proceed at once to rapidly draw out and develop the incipient cells. The merit of this invention is also somewhat in dispute. Upward of twenty years ago the late eminent apiarist, S. Wagner, patented comb-foundation in the United States; but it soon transpired that Herr Mehring, in Germany, had previously made foundation, and that the Germans

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had been using it for three or four years. As it is the accumulated wit and experience of the age, rather than the man, that produces the invention, it is quite likely that Mr. Wagner arrived at the idea without the aid of the other German (for Mr. Wagner was himself a German). Montaigne said he "had as clear a right to think Plato's thoughts as Plato himself had"; and the American German had not only as good a right as the home Teuton to think out this invention, but he was just as likely to do so, and more likely, for the inspiriting and inventive Yankee atmosphere would quicken his blood and sharpen his wits.

Recent bee-culture has been also greatly promoted and extended by the specialty of queen-rearing, which has been brought to great perfection on scientific principles. D. A. Jones, in Canada, and Henry Alley, in the United States, have developed this department of apiculture to an extent leaving, one would think, little to be further achieved or desired. As, however, under the progressive laws of evolution, we have ceased to set bounds to improvement in anything not fixed mathematically, we will not say that any department of practical apiculture is yet fully wrought out to perfection.

In order to secure absolute purity of fertilization in the different varieties and sub-varieties in crossing, D. A. Jones, of Beeton, Ontario, has established queen-nurseries on different islands in Georgian Bay, so far from shore and from each other as to secure entire purity of blood in copulation. Queens and drones bred and mated under such circumstances, from pure imported stock, cannot be otherwise than pure.

Henry Alley also, of Wenham, Mass., has, through a long series of experiments during many years, successfully applied science to the *modus operandi* of queen-rearing, and has recently given the world the fruits of his labors and researches in a work entitled "The Bee-Keeper's Handy Book; or, Twenty-two Years' Experience in Queen-Rearing."

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THE MICROBES OF ANIMAL DISEASES.

BY E. L. TROUESSART.

THE first of the virulent and contagious diseases in which the presence of a microbe was positively ascertained was anthrax, or splenic fever, which attacks most of our horned animals, and especially cattle and sheep.

As early as 1850, Davaine had observed the presence of minute rods in the blood of animals which died of *splenic fever;* but it was only in 1863, after Pasteur's first researches into the part played by microbes in fermentations, that Davaine suspected these rods of being the actual cause of the disease. He inoculated healthy animals with the tainted blood, and thus ascertained that even a very minute dose would produce a fatal attack of the disease, and the rods, to which he gave the name of *Bacteridia*, could always be discovered in enormous numbers in the blood.

The microbe so named by Davaine must from its characteristics be assigned to the genus Bacillus, and is now termed *Bacillus anthracis*. This disease, which affects men as well as animals, is characterized by general depression, by redness and congestion of the eyes, by short and irregular respiration, and by the formation of abscesses, which feature, in the case of the human subject, has procured for it the name of *malignant pustule*. The disease is quickly terminated by death, and an autopsy shows that the blood is black, that intestinal hemorrhage has occurred, and that the spleen is abnormally large, heavy, and gorged with blood; hence the name of *splenic fever*. The disease is generally inoculated by the bite of flies which have settled upon

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carcasses and absorbed the bacteria, or by blood-poisoning through some accidental scratch, and this is especially the case with knackers and butchers who break and handle the bones of animals which have died of anthrax.

The period of incubation is very short. An ox which has been at work may return to the stall apparently healthy. He eats as usual; then lies down on his side and breathes heavily, while the eyes are still clear. Suddenly his head drops, his body grows cold; at the end of an hour the eye becomes glazed; the animal struggles to get up and falls dead. In this case, the illness has only lasted for an hour and a half.

In order to prove that the disease is really caused by *Bacillus anthracis*, Pasteur inserted a very small drop of blood, taken from an animal which had recently died of anthrax, in a glass flask which contained an infusion of yeast, neutralized by potassium and previously sterilized. In twenty-four hours the liquid, which had been clear, was seen to be full of very light flakes, produced by masses of bacilli, readily discernible under the microscope. A drop from the first flask produced the same effect in a second, and from that to a third, and so on. By this means the organism was completely freed from all which was foreign to it in the original blood, since it is calculated that, after from eight to ten of such processes, the drop of blood was diluted in a volume of liquid greater than the volume of the earth. Yet the tenth, twentieth, and even the fiftieth infusion would, when a drop was inserted under the skin of a sheep, procure its death by splenic fever, with the same symptoms as those produced by the original drop of blood. The bacillus is, therefore, the sole cause of the disease.

These cultures have often since been repeated by numerous observers, so that the microbe has been studied in all its forms, and the extent of its polymorphism has been ascertained. At the end of two days the bacterium, which, while still in the blood, is of a short abrupt form, displays excessively long filaments, which are sometimes rolled up like a coil of string. In about a week many of the filaments contain refracting, somewhat elongated nuclei. These nuclei presently form chaplets, in consequence of the rupture of the cell-wall of the rod which gave

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birth to them; others, again, float in the liquid in the form of isolated globules. These nuclei are the spores or germs of the microbes, which germinate when placed in the infusion, become elongated, and reproduce fresh bacilli.

These spores are much more tenacious of life than the microbes themselves. The latter perish in a temperature of 60°, by desiccation, in a vacuum, in carbonic acid, alcohol, and compressed oxygen. The spores, on the other hand, resist desiccation, so that they can float in the air in the form of dust. They also resist a temperature of from 90° to 95°, and the effects of a vacuum, of carbonic acid, of alcohol, and compressed oxygen.

In 1873 Pasteur, aided by Chamberland and Roux, carried on some experiments on a farm near Chartres, in order to discover why this disease is so common in some districts, in which its spread cannot be ascribed to the bite of flies. Grass, on which the germs of bacteridia had been placed, was given to the sheep. A certain number of them died of splenic fever. The glands and tissues of the back of the throat were very much swelled, as if the inoculation had occurred in the upper part of the alimentary canal, and by means of slight wounds on the surface of the mucous membrane of the mouth. In order to verify the fact, the grass given to the sheep was mixed with thistles and bearded ears of wheat and barley, or other prickly matter, and in consequence the mortality was sensibly increased.

In cases of spontaneous disease it was surmised that the germs which were artificially introduced into food in the course of these experiments are found upon the grass, especially in the neighborhood of places in which infected animals had been buried. It was, in fact, ascertained that these germs existed above and around the infected carcasses, and that they were absent at a certain distance from their burial-place. It is true that putrid fermentation destroys most of the bacteria, but before this occurs a certain number of microbes are dispersed by the gas disengaged from the carcass; these dry up and produce germs which retain their vitality in the soil for a long while.

The mechanism by means of which these germs are brought to the surface of the soil and on to the grass on which the sheep feed is at once simple and remarkable. Earth-worms prefer soils

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which are rich in humus or decomposing organic substance, and seek their food round the carcass. They swallow the earth containing the germs of which we have spoken, which they deposit on the surface of the soil, after it has traversed their intestinal canals, in the little heaps with which we are all acquainted. The germs do not lose their virulence in their passage through the worms' intestines, and, if the sheep swallow them together with the grass on which they browse, they may contract the disease. The turning-up of the soil by the spade or plow may produce the same effect.

A certain warmth is necessary for the formation of germs; none are produced when it falls below 12°, and the carcasses buried in winter are therefore less dangerous than those buried in the spring and summer. It is, in fact, in hot weather that the disease is most prevalent. Animals may, however, contract it even in their stalls from eating dry fodder on which germs of these bacteria remain.

Pasteur and his pupils performed an experiment in the Jura in 1879, which clearly shows that the presence of germs above the trenches in which carcasses have been buried is the principal cause of inoculation. Twenty oxen or cows had perished, and several of them were buried in trenches in a meadow where the presence of these germs was ascertained. Three of the graves were surrounded by a fence, within which four sheep were placed. Other sheep were folded within a few yards of the former, but in places where no infected animals had been buried. At the end of three days three of the sheep folded above the graves had died of splenic fever, while those excluded from them continued to be healthy. This result speaks for itself.

Malignant pustule, which is simply splenic fever, affects shepherds, butchers, and tanners, who handle the flesh and hide of tainted animals. Inoculation with the bacillus almost always occurs in consequence of a wound or scratch on the hands or face. In Germany, fatal cases of anthrax have been observed, in which the disease has been introduced through the mouth or lungs, as in the case of the sheep observed by Pasteur. The human subject appears, however, to be less apt to contract the disease than herbivora, since the flesh of animals affected by

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splenic fever, and only killed when the microbe is fully developed in the blood, is often eaten in farm-houses. In this case the custom prevalent among French peasants of eating overcooked meat constitutes the chief safeguard, since the bacteria and their germs are thus destroyed.

The rapidity with which anthrax is propagated by inoculation generally renders all kinds of treatment useless; if, however, the wound through which the microbe is introduced can be discovered, it should be cauterized at once. This method is often successful in man. The pustule is cauterized with red-hot iron, or with bichloride of mercury and thymic acid, two powerful antiseptics, certain to destroy the bacteridium. It is expedient, as a hygienic measure, to burn the tainted carcasses, and, if this is not done, they should be buried at a much greater depth than is usually the case.

But the preservative means on which chief reliance is now placed is vaccination with the virus of anthrax. Pasteur has ascertained that when animals are inoculated with a liquid containing bacteridia of which the virulence has been attenuated by culture carried as far as the tenth generation, or even further, their lives are preserved. They take the disease, but generally in a very mild form, and it is an important result of this treatment that they are henceforward safe from a fresh attack of the disease; in a word, they are *vaccinated* against anthrax.

In the cultures prepared with the view of attenuating the microbe, it is the action of the oxygen of the air which renders the bacteridium less virulent. It should be subjected to a temperature of from 42° to 43° in the case of *Bacillus anthracis*, to enable it to multiply, and at the same time to check the production of spores which might make the liquid too powerful. At the end of the week, the culture, which at first killed the whole of ten sheep, killed only four or five out of ten. In ten or twelve days it ceased to kill any; the disease was perfectly mild, as in the case of the human vaccinia. After the bacteridia have been attenuated they can be cultivated in the lower temperature of from 30° to 35°, and only produce spores of the same attenuated strength as the filaments which form them.

The vaccine thus obtained in Pasteur's laboratory is now dis-

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tributed throughout the world, and has already saved numerous flocks from almost certain destruction. Although this process has only been known for a few years, its results are such that the gain to agriculture already amounts to many thousands of pounds.

Toussaint makes use of a slightly different mode of preparing a vaccine virus, which is, however, analagous to that of Pasteur. He subjects the lymph of the blood of a diseased animal to a temperature of 50°, and thus transforms it into vaccine. Toussaint considers the high temperature to be the principal agent of attenuation, and ascribes little or no importance to the action of the oxygen in the air.

Chamberland and Roux have recently made researches with the object of obtaining a similar vaccine by attenuating the primitive virus by means of antiseptic substances. They have ascertained that a solution of carbolic acid of one part in six hundred destroys the microbes of anthrax, while they can live and flourish in a solution of one part in nine hundred, but without producing spores, and their virulence is attenuated. When a nourishing broth is added to a solution of one in six hundred, the microbe can live and grow in it for months. Since the chief condition of attenuation consists in the absence of spores, this condition seems to be realized by the culture in a solution of carbolic acid, one in nine hundred, and it is probable that a fresh form of attenuated virus may thus be obtained. Diluted sulphuric acid gives analogous results. However this may be, the vaccine prepared by Pasteur's process is the only one which has been largely used, and which has afforded certain results to cattle-breeders.

Public experiments, performed before commissions composed of most competent men, have clearly shown the virtue of the protective action. In the summer of 1881 the initiation was taken by the Melun Society of Agriculture. Twenty-five sheep and eight cows or oxen were vaccinated at Pouilly-le-Fort, and then re-inoculated with blood from animals which had recently died of anthrax, together with twenty-five sheep and five cows which had not been previously vaccinated. None of the vaccinated animals suffered, while the twenty-five test-sheep died within forty-eight hours, and the five cows were so ill that the veterinary surgeons despaired of them for several days.

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This experiment was publicly repeated in September, 1881, by Thuillier, Pasteur's fellow-worker, whose death we have recently had to deplore, before the representatives of the Austro-Hungarian government; and again near Berlin, in 1882, before the representatives of the German government, and always with the same success. Up to April, 1882, more than one hundred and thirty thousand sheep and two thousand oxen or cows had been vaccinated; and since that time the demand for vaccine from Pasteur's laboratory has reached him from every quarter.

The sickness of barn-door poultry, which is commonly called cholera, is caused by the presence in the blood of a small micrococus or bacterium in the form of the figure 8, differing, therefore, in form from *Bacillus anthracis*, but also an aërobie. It may be cultivated in chicken-broth, neutralized by potash, while it soon dies in the extract of yeast, which is so well adapted to *Bacillus anthracis*. The microbe of this disease may also be attenuated by culture, and it may be done more easily than in the case of anthrax, since it is not necessary to raise the temperature, as the bacterium of fowl-cholera does not produce spores under culture. Pasteur has therefore been able to prepare an attenuated virus well adapted to protect fowls from further attacks of this disease.

The disease affecting swine, which is called *rouget*, or swine-fever, in the south of France, has been recently studied by Detmers in the United States, where it is also very prevalent, and by Pasteur in the department of Vaucluse. It is a kind of *pneumo-enteritis*. These observers consider that the disease is caused by a very slender microbe, formed, like that of fowl-cholera, in the shape of the figure 8, but more minute. Others say that there is a bacillus which was observed by Klein as early as 1878 in swine attacked by this disease. In spite of the apparent contradiction, it is probable that we have only two forms of the same microbe, for the bacillus in Klein's culture at first resembles *Bacterium termo*, in the form of an 8, before it is elongated into rods. Pasteur has succeeded in making cultures of microbes in the figure 8. He has inoculated swine with the attenuated form, after which they have been able to resist the disease, so there is reason to hope that in the near future this

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new vaccine, containing the attenuated microbe, may become the safeguard of our pig-sties.

An epidemic which raged in Paris in 1881 was called the typhoid fever of horses, and was fatal to more than fifteen hundred animals belonging to the General Omnibus Company in that city. This disease is also produced by a microbe, with which Pasteur was able to inoculate other animals (rabbits); for this purpose he made use of the serous discharge from the horses' nostrils. The inoculated rabbits died with all the symptoms and lesions characteristic of the disease. The attenuation of this microbe by culture is difficult, since at the end of a certain time the action of the air kills it. Pasteur has, however, found an expedient by which to accomplish his purpose. When the culture is shown to be sterile in consequence of the death of the microbe, he takes as the mother-culture of a fresh series of daily cultures the one which was made on the day preceding the death of the first mother-culture. In this way he has obtained an attenuated virus with which to inoculate rabbits, and the same result might undoubtedly be obtained in the case of horses.

There are many other contagious diseases which affect domestic animals, and which are probably due to microbes, such as, for instance, the infectious pneumonia of horned cattle. This was probably the first disease in which the protective effects of inoculation were tried, according to Wilhelm's method. This method consisted in making an incision under the animal's tail with a scalpel dipped in the purulent mucus or blood taken from the lung of a beast which had died of pneumonia; sometimes the serous discharge from the swelling under the tail of an inoculated animal was used for others. Fever and loss of appetite ensued, lasting from eight to twenty-five days, but the animal was afterward safe from further attacks of the disease. Cattle-plague, or contagious typhus, is likewise ascribed to the presence of a microbe with which we are as yet imperfectly acquainted.

Experimental septicæmia is entitled to special mention, since it has too often been confounded with anthrax, and has been unskillfully produced with the intention of vaccinating animals in accordance with Pasteur's process. This occurs when too long an interval (twenty-four hours) elapses after the death of an

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animal, before taking from it the blood intended for vaccine cultures. After this date the blood no longer contains *Bacillus anthracis*, which is succeeded by another microbe termed *vibrio septicus*, differing widely from the anthrax microbe in form, habit, and character. *Bacillus anthracis* is straight and immobile, while the septic vibrio is sinuous, curled, and mobile. Moreover, it is anaërobic, and does not survive contact with the air, but it thrives in a vacuum or in carbonic acid. Since *Bacillus anthracis* is, on the other hand, an aërobie, it is clear that the two microbes cannot exist simultaneously in the blood or in the same culture-liquid. The inoculation with this fresh microbe is no less fatal; its action is even more rapid than that of *Bacillus anthracis*, but the lesions are not the same; the spleen remains normal, while the liver is discolored. The septic vibrio is only found in minute quantities in the blood, so that it has escaped the notice of many observers. It is, however, found in immense numbers in the muscles, in the serous fluid of the intestines, and of other organs. It is very common in the intestines, and is probably the beginning of putrefaction.

Rabies is a canine disease which is communicated by a bite, and the inoculation of man and other animals by the saliva. We are not yet precisely acquainted with the microbe which causes the disease, but Pasteur's recent researches have thrown considerable light on its life-history, which is still, however, too much involved in obscurity. It must first be observed that the hypothetical microbe of rabies, which no one has yet discovered, should not be confounded with the microbe of human saliva; this is found in the mouths of healthy persons.

The following conclusions are the result of Pasteur's researches into the virus of rabies.

This virus is found in the saliva of animals and men affected by rabies, associated with various microbes. Inoculation with the saliva may produce death in three forms: by the salivary microbe, by the excessive development of pus, and finally by rabies. The brain, and especially the medulla oblongata, of men and animals which have died of rabies, is always virulent until putrefaction has set in. So also is the spinal cord. The virus is, therefore, essentially localized in the nervous system.

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Rabies is rapidly and certainly developed by trephining the bones of the cranium, and then inoculating the surface of the brain with the blood or saliva of a rabid animal. In this way there is a suppression of the long incubation which ensues from simple inoculation of the blood by a bite or intravenous injection on any part of the body. It is probable that in this case the spinal cord is the first to be affected by the virus introduced into the blood; it then fastens on its tissues and multiplies in them.

As a general rule, a first attack which has not proved fatal is no protection against a fresh attack. In 1881, however, a dog, which had displayed the first symptoms of the disease of which the other animals associated with him had died, not only recovered, but failed to take rabies by trephining, when re-inoculated in 1882. Pasteur is now in possession of four dogs which are absolutely secured from infection, whatever be the mode of inoculation and the intensity of the virus. All the other test-dogs which were inoculated at the same time died of rabies. In 1884 Pasteur found the means of attenuating the virus. For this purpose he has inoculated a morsel of the brain of a mad dog into a rabbit's brain, and has passed the virus proceeding from the rabbit through the organism of a monkey, whence it becomes attenuated and a protective vaccine for dogs. This is the first step toward the extinction of this terrible disease.

Glanders, again, is a disease easily transmitted from horses to man. Glanders, or farcy, is caused by the presence of a bacterium, observed as early as 1868 by Christot and Kiener, and more recently studied at Berlin by Schütz and Löfler. This microbe appears in the form of very fine rods (*bacillus*) in the lungs, liver, spleen, and nasal cavity. Babès and Havas found this bacillus in the human subject in 1881. Experimental cultures have been made simultaneously in France and Germany, and have given identical results.

Bouchard, Capitan, and Charrin made their cultures in neutralized solutions of extract of meat, maintained at a temperature of 37°. By means of successive sowings, they have obtained the production of unmixed microbes, presenting no trace of the original liquid, and this was done in vessels protected from air-germs. These cultures may be carried to the eighth generation.

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Asses and horses inoculated with liquid containing the microbes produced by this culture have died with the lesions characteristic of glanders (glanderous tubercles in the spleen, lungs, etc). Cats and other animals which have been inoculated in the same way died with glanderous tubercles in the lymphatic glands and other organs.

It follows from these experiments that the microbe which causes this disease is always reproduced in the different culture-liquids with its characteristic form and dimensions; that uni-ungulates can be inoculated with it, as well as man and other animals. In fact, this microbe is the essential cause of the disease.

We have already spoken of muscardine, a silk-worm's disease produced by a microscopic fungus; two other diseases are caused by distinct microbes, of which we must shortly speak. In the silk-worm nurseries, in which this disease prevails, the silk-worms which issue from the eggs, technically called seed, are slowly and irregularly developed, so as to vary greatly in size. Many die young, and those which survive the fourth molt shrink and shrivel away; they can hardly creep on to the heather to spin their cocoon, and produce scarcely any silk.

On an examination of the worms which have died of this disease, De Quatrefages ascertained the presence of minute stains on the skin and in the interior of the body, which he compared to a sprinkling of black pepper; hence the name *pebrine*. Under the microscope these stains assume the form of small mobile granules like bacteria, which Cornalia termed vibratile corpuscles, on account of their movements. Finally, Osimo and Vittadini ascertained the existence of these corpuscles in the eggs, and consequently showed that the epidemic might be averted by the sole use of healthy eggs, of which the soundness should be established by microscopic examination.

It was at about this date (1865) that Pasteur undertook the exhaustive study of pebrine; but Béchamp was the first to pronounce the disease parasitic, resembling muscardine in this respect, and caused by the attacks of a microbe — or microzyma, to adopt Béchamp's name — of which the germ or spore is derived from the air, at first attacking the silk-worm from with-

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out, but multiplying in its interior, and developing with its growth, so that the infected moth is unable to lay its eggs without depositing the spores of the microbe at the same time, and thus exposing the young grub to attack as soon as it is born. Pasteur's own researches soon induced him to adopt the same view. The pebrine microbe was long regarded as a true bacterium, successively described as *Bacterium bombycis*, *Nosema bombycis*, and *Panistophyton ovale*. Balbiani's recent researches tend to show that it should be assigned to another group, much nearer to animals, and designated *Sporozoaria*. These protista, still regarded as plants by many naturalists, chiefly differ from bacteria by their mode of growth and reproduction, in which they resemble the parasitic protozoaria, termed *Psorospermia*, *Coccidies*, and *Gregarinidæ*.

In *Sporozoaria*, growth by fission, the rule in all bacteria, has not been observed; this distinction is fundamental. Sporozoaria multiply by free spore-formation in a mass of sarcode substance (protoplasm), resulting from the encysting of the primitive corpuscles (mother-cells). The formation of numerous spores may be observed within the mother-cells, having the appearance of *pseudonavicellæ* or spores of gregarinidæ and psorospermia (parasites of vertebrate animals). Balbiani forms these organisms, which are found in many insects, into a small group, which he terms *Microsporidia*.

The ripe spores are the vibratile corpuscles of Cornalia. They closely resemble the spores of some bacilli (*B. amylobacter*, for instance), and their germination is likewise effected by perforation of the spore at one end, and issue of the protoplasm from the interior. This, however, does not issue in a rod-like form (*Bacillus*), but in that of a small protoplasmic mass, with amœboid movements, a characteristic not observed in any bacterium. The other species of silk-worms which have been recently introduced, notably the oak silk-worm from China (*Attacus Pernyi*), are attacked by microsporidia analogous to those of pebrine.

Pasteur has indicated the mode of averting the ravages of this disease. He has thus addressed the breeders: "If you wish to know whether a lot of cocoons will yield good seed, separate

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a portion of them and subject them to heat, which will accelerate the escape of the moth by four or five days, and examine them under the microscope to ascertain whether corpuscles of pebrine are present. If they are, send all the cocoons to the silk factory. If they are not diseased, allow them to breed, and the seed will be good and will hatch out successfully. In a word, start with absolutely healthy seed, produced by absolutely pure parents, and rear them under such conditions of cleanliness and isolation as may insure immunity from infection." When the disease is developed, fumigation with sulphurous acid is recommended, or preferably with creosote or carbolic acid, which do not affect the silk-worms and which hinder the development of microsporidia. These fumigations likewise keep the litter from becoming corrupt, and in a properly conducted nursery the litter is kept dry.

Wrongly confounded with pebrine, the disease *flacherie* is still more destructive to silk-worms. The symptoms are remarkable. The rearing of silk-worms often goes on regularly up to the fourth molt, and success seems assured, when the silk-worms suddenly cease to feed, avoid the leaves, become torpid, and perish, while still retaining an appearance of vitality, so that it is necessary to touch them in order to ascertain that they are dead. In this state they are termed *morts-flats*. A few days, sometimes even a few hours, suffice to transform the most flourishing nursery into a charnel-house. Pasteur examined these *morts-flats* and found that the leaves contained in the stomach and intestine were full of bacteria, resembling those which are developed when the leaves are bruised in a glass of water and left to putrefy. In a healthy specimen, of good digestion, these bacteria are never found. It is therefore evident that the disease is owing to bad digestion, and becomes rapidly fatal in animals which consume an enormous amount of food, and do nothing but eat from morning to night. The digestive ferments of unhealthy silk-worms do not suffice to destroy the bacteria of the leaves, nor to neutralize their injurious effects. These bacteria are really the cause of the disease, for if even a minute quantity of the leaves taken from the intestine of diseased silk-worms be given to healthy specimens they soon die of the same disease. It is, therefore, essentially contagious, and, in order to prevent

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the diseased silk-worms from contaminating the healthy by soiling the leaves on which the latter are about to feed, as much space should be assigned to them as possible.

Good seed should also be selected, since it has been ascertained that some lots of seed are more liable to the disease than others. The affection does not indeed begin in the egg, as in pebrine, but the question of heredity comes in. It is clear that, when a silk-worm has been affected by *flacherie* without dying of it, its eggs will have little vitality, and the grubs which issue from them will be predisposed by their feeble constitution to contract the disease.

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NITRIFICATION.

BY PROFESSOR H. P. ARMSBY, IN SCIENCE MONTHLY.

THE production of nitrates during the decay of nitrogenous organic matter under suitable conditions of moisture, aëration, and temperature, is a reaction of no little importance both technically and agriculturally: technically, as the sole natural source of saltpeter; agriculturally, on account of the fact that the nitrates formed in the soil constitute the chief if not the only supply of nitrogen to the plant. But, while the conditions of nitrification have long been well known, it is only within the past eight or nine years that its true cause has been recognized. Pasteur, in 1862, appears to have first pointed out the similarity of nitrification to the various oxidations of organic matter known to be effected by the agency of mycoderms, and of which the acetic fermentation is the typical example.

In 1873 A. Müller advanced the opinion that nitrification was due to the action of a ferment. He based his opinion upon the fact that solutions of pure ammonium salts and of urea are very stable, while the same bodies in sewage are rapidly nitrified, holding that the difference was due to the presence of a ferment in the latter case. In 1877 Schloesing and Müntz published the results of experiments which indicated that Pasteur's suggestion and Müller's opinion were correct, and that nitrification might really be classed as a fermentation. These experimenters were engaged in investigating the oxidizing effect of the soil upon sewage. They filled a glass tube one meter long with a mixture of quartz, sand, and a small quantity of powdered limestone,

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and caused sewage to filter slowly through this artificial soil, so that it occupied eight days in passing through the tube. For twenty days the sewage passed through unaltered. Then nitrates began to appear in it, and rapidly increased in amount until all the nitrogen of the filtrate was in this combination. If nitrification is due to simple oxidation, it is difficult to see why it was so slow in commencing; but, if it is due to an organism which required time to develop in the artificial soil, the delay is at once explained.

Sewage was passed through the soil in this way for four months, with complete oxidation of its nitrogen. As soon, however, as vapor of chloroform, which is known to be inimical to the action of organized ferments, was caused to penetrate the soil, nitrification ceased, and did not recommence after the chloroform was withdrawn. After the sewage had passed unchanged for seven weeks, a small amount of turbid washings of a soil known to nitrify with ease was poured upon the top of the soil. After eight days (*i. e.*, exactly the time required for the liquid to traverse the column of soil), nitrates re-appeared in the strata, and continued to be formed as long as the experiment was continued. All these facts point plainly to an organism as the cause of nitrification. It developed in the soil during the first twenty days of the experiment from germs introduced by air or sewage; it was killed by the chloroform-vapor and re-introduced in the soil-washing.

In 1878 appeared the results of experiments made by Warrington in the Rothamsted Laboratory, which fully confirmed those of Schloesing and Müntz. He first showed that a very considerable nitrification took place in a good garden-soil when a current of air was aspirated through the moist soil, but that hardly any formation of nitrates took place when this air contained vapors of chloroform or carbon disulphide, while vapor of carbolic acid seemed to produce the same effect so far as it was brought in contact with the soil. Thus far the results were simply confirmatory of those of Schloesing and Müntz. Further experiments, however, developed the important fact that nitrification could be brought about in dilute solutions of ammonium salts, by seeding them with a small amount either of a nitrifying

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soil or of a similar solution which had undergone nitrification. The first experiments were made with the dilute solutions employed in the determination of ammonia by Messler's method, with the addition of small quantities of tartrate and phosphate of potassium, and precipitated carbonate of calcium. The solutions used in later experiments had the following composition per liter: —

Ammonium chloride	80	milligrammes.
Sodium potassium tartrate	80	"
Potassium phosphate	40	"
Magnesium sulphate	20	"

Precipitated calcium carbonate was added to supply the necessary base. By this discovery the way was opened for the easy and fruitful study of the process and of the conditions affecting it.

Since the publication of Warrington's paper, a large amount of work has been done in this direction both by this investigator and by others. As a result, the ferment theory of nitrification has been very thoroughly established, the organism producing it has been isolated, and considerable progress made in the study of the conditions affecting nitrification, particularly in fluid media.

That nitrification is due to the action of a living organism is shown in various ways. Sterilized solutions, otherwise suitable for nitrification, have been preserved for as long as three years unchanged. But, if to such a solution a small amount of a solution or a soil in which nitrification has recently taken place be added, the solution nitrifies within a short time.

Nitrification is strictly confined to the range of temperature within which the action of low organisms is possible. It does not take place unless all the nutritive materials necessary for such organisms are present, absence of phosphoric acid, for example, completely preventing it. Antiseptics, as already illustrated, inhibit nitrification. The action of heat likewise confirms the ferment theory. The temperature of boiling water at once stops nitrification, and it is not resumed until the medium is seeded again from some external source.

Some of the more important conditions affecting nitrification

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in liquids (and presumably also in porous solids, such as soil) are: 1. Alkalinity of the solution; 2. Concentration of the solution; 3. Character and amount of the ferment; 4. Temperature.

1. While nitrification does not take place in the absence of a salifiable base, any considerable degree of alkalinity greatly retards it, and, if it exceeds the equivalent of about three hundred and fifty parts of nitrogen per million, stops it.

2. Under like circumstances, nitrification begins more promptly the more dilute the solution. No definite limit of concentration can be stated, beyond which nitrification cannot take place on account of the great differences caused by differences in the —

3. Character and amount of the ferment. The character of the ferment is determined by its previous history. A strong ferment, producing prompt and rapid nitrification, is obtained by repeated cultivations in moderately strong solutions well supplied with nutritive matter, while the opposite course produces a weak ferment. The stronger the ferment, and the greater the amount of it used for seeding, the sooner the nitrification begins, and the greater is the admissible concentration of the solution.

4. Nitrification has been observed to take place at a mean temperature of 3.2° C. The superior limit seems to be 40° to 50° C., the optimum 35° to 37° C.

A variety of nitrogenous substances have proved susceptible to nitrification in solution. The weight of evidence, however, appears to show that in all cases the nitrogen first assumes the form of ammonia, and that the latter is, strictly speaking, the only substance capable of being nitrified. In the case of urea this has been observed to lead to some interesting results. Thus, if nitrification is induced in a solution of urea containing no salifiable base, the process stops when one half the nitrogen has been oxidized, ammonium nitrate being produced. If the concentration exceeds a certain limit no nitrification occurs, the alkalinity produced when the urea is converted into ammonium carbonate being sufficient to prevent the action of the ferment. If, however, gypsum be present, the well-known double decomposition into calcium carbonate and ammonium sulphate takes place, and, the latter having a neutral reaction, nitrification proceeds unhindered.

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An interesting and hitherto unexplained fact which was noticed in Warrington's experiments is, that sometimes nitrous and sometimes nitric acid was produced, and at times both in the same solution. The experiments thus far published suggest the possibility of the existence of two ferments, a nitric and a nitrous, but on this branch of the subject we may expect more light when investigations now in progress at Rothamsted are made public.

Some investigations into the distribution of the nitric ferment in natural soil are summarized by Warrington as follows: "I am disposed to conclude that in our clay soils the nitrifying organism is not uniformly distributed much below nine inches from the surface. On much lighter grounds it may perhaps be assumed that the organism is sparsely distributed down to eighteen inches, or, possibly, somewhat farther. At depths of from two feet to eight feet there is no trustworthy evidence to show that the clay contains the nitrifying organism. It is, however, probable that the organism may occur in the natural channels which penetrate the subsoil at a greater depth than in the solid clay. In the case of sandy soils we may probably assume that the organism will be found at a lower depth than in clays."

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NEW HAMPSHIRE AGRICULTURE.

SIXTEENTH ANNUAL REPORT

OF THE

BOARD OF AGRICULTURE

FROM

JUNE 1, 1886, TO MAY 1, 1887.

BY JAMES O. ADAMS, SECRETARY.

MANCHESTER:
JOHN B. CLARKE, PUBLIC PRINTER.
1887.

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BOARD OF AGRICULTURE.

ORGANIZED AUGUST 23, 1870.

MEMBERS.

MOSES HUMPHREY, *Chairman* . . .	Concord.
JAMES O. ADAMS, *Secretary* . . .	Boscawen.
W. H. H. MASON	Moultonborough.
HIRAM PARKER	Lempster.
JASON S. PERRY	Rindge.
ALBERT DEMERITT	Durham.
JOSEPH FARNUM	Peterborough.
SIDNEY B. WHITTEMORE	Colebrook.
JOHN E. CARR	North Haverhill.
JOHN D. LYMAN	Exeter.
GEORGE S. PHILBRICK	Tilton.

Nahum J. Bachelder of Andover was elected secretary, February 23, 1887, to fill the vacancy made by the death of Mr. Adams.

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AGRICULTURAL ROOMS,
CONCORD, N. H., May 1, 1887.

To His Excellency the Governor:

The sixteenth annual report of the Board of Agriculture from June 1, 1886, to May 1, 1887, is herewith submitted.

N. J. BACHELDER, *Secretary.*

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REPORT.

JAMES O. ADAMS, who held the office of secretary of the Board of Agriculture from its organization, August 23, 1870, to the time of his death, was born in East Concord, June 5, 1818.

He learned the trade of a printer at Concord, fitted for college at Lyndon, Vermont, and graduated from Dartmouth in 1843. He was principal of Lyndon Academy for awhile, afterwards located in Manchester, reading law while teaching also in the city of Manchester, where he resided for many years. Mr. Adams was nine years editor and publisher of the "American," during which time he established and for six years published the "Granite State Farmer." He also edited the "Mirror and American," for a time. He served as clerk of his ward for six years and moderator nine years; was a member of the common council in 1847 and 1848, and president in the latter year. He was a member of the school committee of Manchester four years, and superintendent of schools from 1855 to 1859 and from 1861 to 1867.

He was a member of the Legislature from Manchester in 1852 and afterwards elected nine times to that body. He was the Republican candidate for speaker in 1871, when the Legislature was carried by the Democrats; was five years secretary of the New Hampshire Agricultural Society and edited first five printed volumes of their report, and was a delegate from this society to the World's Fair in London in 1851. He died on his farm at Boscawen, after a brief illness, February 7, 1887. During his life he was interested in school affairs and was a member of the school board of Boscawen at the time of his death. His long connection with the Board of Agriculture gave him a wide

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acquaintance throughout the State and his genial disposition won him many friends. The fifteen annual reports which he edited are a valuable contribution to the agricultural literature of the State and will remain a lasting testimonial to his interest in the development of agriculture in New Hampshire.

The duties of the office were assumed by the present secretary, March 1, 1887. The preceding report for the year ending June 1, 1886, had been prepared by Mr. Adams and was in the hands of the printer. Undoubtedly it was the intention of the previous secretary to extend the report but from what material we are unable to determine.

Believing it to be for the advantage of the farming interests that the Agricultural Report be issued to date, we have collected from such sources as are available and arranged the matter which follows, and present it as the report to May 1, 1887. It is not as complete as we would wish, but we express the hope that the reader will rightly consider the circumstances in which we are placed, and the difficulties in the way of a lengthy report. We are under obligation to various gentlemen for assistance in its preparation. We are specially indebted to Hon. Joseph B. Walker, of Concord, E. J. Burnham, of the "Manchester Union," James L. Gerrish, of Webster, James M. Connor, of Hopkinton, and the various newspapers which have been made available. The information solicited from the members of the Board has been given with uniform courtesy. The papers at the close of the report were, in part, arranged for by Mr. Adams, and in other instances furnished at our solicitation.

ANNUAL MEETING AT BOAR'S HEAD.

The first meeting, which was the annual meeting of the Board, was held at Boar's Head, August 18 and 19, 1886. The meeting on the first day was a business session and the second a field day. Many leading agriculturists of the State were present, and it was considered an eminent success. The following report of the meeting by E. J. Burnham appeared in the "Manchester Union":

"The idea of having a farmers' field day in connection with

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the annual meeting of the State Board of Agriculture was happily carried out and proved a grand success. The day was fair and the view of the ocean exceptionally fine. The arrangements for the occasion, taken in hand by Mr. S. B. Dumas of the Boar's Head House, were elaborate and complete in every particular. A canvas pavilion was spread on the bold promontory at the rear of the hotel and abundantly supplied with seats, and the atmosphere was so mild that overcoats were unthought of, as the large company of visitors enjoyed themselves in the open air.

"The members of the Board met on the evening of the 18th for the purpose of laying out its work for the coming fall and winter, and in the absence of the chairman, Hon. Moses Humphrey, who was unavoidably detained, S. B. Whittemore, of Colebrook, was chosen chairman *pro tem.* Messrs. Joseph Farnum, of Peterborough, recently appointed the successor to Hon. D. H. Goodell, of Antrim, as member for Hillsborough county, and J. S. Perry, of Rindge, successor to Hon. G. K. Harvey, of Surry, for Cheshire county, were present at a meeting of the Board for the first time. In the discussion of plans for the future the secretary, Hon. James O. Adams, of Boscawen, snggested that a week each be given to canvassing the several counties of the State the coming season, and that meetings be held wherever there appeared to be the greatest demand. It was agreed by the Board that the suggestion should be adopted, and that the member for each county with the secretary and such co-operation as they could secure should do the work in that county. Mr. DeMeritte for Strafford county and Mr. Philbrick for Belknap were instructed to arrange for meetings to be held consecutively at central points in those counties at such time in October or November as seemed advisable. The second week in November was assigned to Coös, covering that section from Groveton via Berlin and Milan to Dummer, Errol, Colebrook, and Stratford Hollow. Arrangements for other counties were left with the local members and the secretary.

"At a comparatively early hour on the 19th the company began to gather in goodly numbers, and by two o'clock there were long lines of teams hitched at available points near the Boar's Head

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House, the arrivals consisting of farmers and their families from the towns of Rockingham county, and an unexpected number of people from farther away. Among the more prominent agriculturists and others present were Hon. Moses Humphrey, of Concord, president of the Board, Hon. J. O. Adams, of Boscawen, secretary, Hon J. D. Lyman, of Exeter, S. B. Whittemore, of Colebrook, George S. Philbrick, of Tilton, Albert DeMeritte, of Durham, Joseph Farnum, of the 'Peterborough Transcript,' and J. S. Perry, of Rindge, all members of the Board; Col. Thomas Cogswell, of Gilmanton, Hon. D. H. Goodell, of Antrim, and Col. J. M. Weare, of Seabrook, ex-members; Col. W. H. Stinson, of Dunbarton, master of the State Grange; A. W. Cheever, of the 'New England Farmer,' President Bartlett, of Dartmouth College, Rev. Dr. Quint, of Dover, Hon. Warren Brown, of Hampton Falls, L. T. Hazen, of Whitefield, J. B. Walker, of Concord, J. L. Gerrish, of Webster, W. H. Hills, Moses Dow, and N. H. Clark, of Plaistow, Past Master William H. Hunnewell, J. W. Odlin, M. B. Morrill, and E. G. Eastman, Esq., of Exeter, A. G. Whittier, of Raymond, Harrison Rowe, of Kensington, and many others.

"The company assembled in the pavilion at about 11 o'clock, and the formal exercises were opened by Secretary Adams in a few spirited remarks. At his request, Hon. J. D. Lyman accepted the position of president of the day and entered upon the discharge of his duties with a bright speech full of humorous personal allusions, a tribute to the late Colonel Clough, of Canterbury, and the suggestion that L. T. Hazen, of Whitefield, was succeeding to the title of 'corn king.'

"The first speaker introduced was Col. Thomas Cogswell, of Gilmanton, who spoke freely without notes, and gave a good, sound farm talk. He said he came from a farmers' meeting at Dover the day before, where he promised Rev. Dr. Quint that he would not talk more politics than the latter talked religion, and he should keep his promise here. He came as an ex-member of the Board of Agriculture, and was proud of the fact that he resigned in favor of a better man, J. W. Sanborn, who filled the position with credit until called first to Hanover, and later to Missouri. He was proud, too, to come here from a farm in Gil-

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manton that had been in the hands of an unbroken line of Thomas Cogswells for 102 years, and of a family which sent eight members to the Revolutionary War whose aggregate term of service was thirty years and whose total height was fifty feet. For himself, when he had looked about him and seen what his ancestors did,—how they had cleared the stony ground, and built stone walls, and labored early and late to make a farm,—he had felt it a shame not to be up and doing something in that line also, and as this was a farmers' meeting he would tell something of what he had done. Two years ago there were on his farm some seven or eight acres of neglected land, bearing only polypodes and willows. It needed draining, plowing, and fertilizing. With four oxen, two horses, and a gang of men, he sodded three acres, and was proud of the fact that in the first two years he had cut therefrom more than twelve tons of good English hay.

"Following Colonel Cogswell, Hon. Moses Humphrey, of Concord, chairman of the Board, hale and vigorous, although nearing his 80th year, spoke of the days when he was a fisherman off that coast a half century ago, and of his interest in agriculture for many years, and of the improvements which had been made in farming methods. Col. J. M. Weare, of Seabrook, indulged in discussion on forestry with Hon. J. D. Lyman, and W. H. Hills, of Plaistow, spoke at some length on his specialty of small fruits.

"After an hour spent in sauntering about the grounds, the company, as many as could, re-assembled in the good-sized pavilion, and S. B. Whittemore, of Colebrook, a member of the Board, and a trustee of the Agricultural College, was the first speaker called. He gave an interesting account of the rich farming section in which he lives, a section almost unknown to people in the southern section of the State, and was followed by G. S. Philbrick, of Tilton, another member of the Board, who spoke on the reduction of the cost of producing milk. At the close of his remarks, Hon. D. H. Goodell, of Antrim, retiring member of the Board, was called, and said he considered that anything that could be done to reduce the cost of farm products while retaining the quality was one of the most important considerations in agriculture. Prices have been falling on every

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hand, and means must be devised to reduce the cost of production. In manufactures, he was glad to know that the price of goods in this country was almost as low as in the older countries, while still giving labor a fair remuneration. He was a farmer himself and was glad that he knew how to plant, mow, pitch, and hoe. He considered agriculture the most honorable business in which men are engaged, and as profitable when put on a business basis. He congratulated the farmers upon their success the present year, and was glad to be able to say that the farming population of New Hampshire is no longer decreasing, because people no longer regard it as a business to escape from.

"At this point Past Master William H. Hunnewell, of Exeter, submitted a proposition that a committee be appointed by the chair to arrange for the holding of a similar meeting here next year, which was unanimously adopted. Short addresses followed by President S. C. Bartlett, of Dartmouth College, A. W. Cheever, of the 'New England Farmer,' Albert DeMeritte, of Durham, Colonel W. H. Stinson, of Dunbarton, who spoke earnestly for the Grange in New Hampshire, A. G. Whittier, of Raymond, L. T. Hazen, of Whitefield, and others, and the formal exercises closed."

COÖS COUNTY MEETINGS.

The series of meetings for Coös county were arranged to commence Monday, November 15, and continue through the week. Assistance in preparing the report of those meetings has been given by Hon. J. B. Walker, who accompanied the members of the Board on that occasion.

The meetings of the Board in Coös county were conducted by Mr. Whittemore, the member of the Board for that county, the secretary, and Mr. J. B. Walker, of Concord. The first was holden in the Methodist church, in Groveton, on the evening of Monday, November 15, and was fairly attended. Mr. Whittemore presided, as he also did at all the meetings held in his county. Having made introductory remarks appropriate to the occasion, he introduced the secretary who spoke upon the subject of the proper management of soils, and was followed by Mr.

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Walker, upon that of the retrograde in most of our New Hampshire farming and the means to be used for its advancement.

The next morning, Tuesday, the representatives of the Board proceeded to Stark, where they dined with Mr. George M. Smith, a good farmer, who showed them a bin of oats, raised the previous season, which weighed fifty pounds to the bushel and yielded at the rate of one hundred bushels to the acre.

There was a good attendance at a meeting held at the town house in the afternoon. The subjects there discussed were, "How to Dress the Farm and Keep it," by the secretary, and "Grass," by Mr. Walker, introduced and followed by remarks by Mr. Whittemore.

The next meeting was held on the evening of the same day at West Milan, seven miles distant. This was in the schoolhouse, and the audience was composed in part of scholars. The selection of the subjects there discussed was governed in part by that fact. The interest of the meeting was enhanced by an exhibition of some of the products of his farm and garden, by Mr. A. A. Higgins, consisting of peas, oats, wheat, honey, and poultry. One of the speakers will ever feel grateful to the splendid Brahmas brought in on that occasion. To illustrate the subject of germination and subsequent plant growth, he had called attention to a kernel of corn which he had drawn in his best style upon the blackboard. "That looks more like a balloon than it does like a kernel of corn," said, in loud whisper, one boy of keen artistic perception to another sitting beside him. Just at this very moment, however, the chickens in the cage began to chirrup their recognition of the familiar grain, and the threatened discomforture of the blackboard artist was changed to a proud triumph.

The next morning, Wednesday, the Board's representatives went, by invitation, to visit Mr. Higgins at what he denominated his "lumberman's camp," some three miles distant from the village. Passing his saw mill and turning sharp to the left soon after, the sleigh was stopped in front of the "camp." This proved to be a one and a half story white house, of liberal proportions, which, but for the snow and the absence of the long veranda, might have been easily mistaken for the house of a well-to-do Southern planter of the olden time.

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The pleasant anticipations awakened by its exterior were more than realized upon entering. Never were humble preachers of the gospel of agriculture on a wearisome circuit more kindly received or agreeably entertained. It was bleak enough without; the somber snow-fall then prevailing and the near presence of dark forests all around made a strongly contrasting background to the bright display of comfort within, presented in cheerful rooms, well-furnished and warmed, adorned on all sides with interesting pictures and blooming plants, as well as by numberless other things of beauty which ladies of good taste always contrive to collect and arrange in a home. A good library, of which was caught a glimpse, and a good piano-forte, expressively played, caused the wish that the subsequent work of the week might be executed on that spot.

But such a wish was vain. Fortified with a sumptuous dinner and cheered by the abounding kindness they had received, the agricultural pilgrims bade a reluctant adieu to Mr. and Mrs. Higgins and daughter and turned their faces towards Dummer. After striking the Androscoggin, they followed down its west bank, some three miles, to Milan Corner Bridge, where they crossed it, and retraced their way up the east bank, about as far, to the open doors of Mr. W. A. Willis, in the southeast part of Dummer, having proved to their entire satisfaction that, on a cold, stormy, and windy day, in Northern New Hampshire, "the longest way round" is not always "the nearest way home." But the travelers soon forgot the wearisome ride in the hearty welcome accorded them. The Dummer meeting was held in the schoolhouse near by, in the evening. Owing to the storm it was less numerously attended than had been anticipated. The discussions were upon farm machinery and horse power, feeding farm animals, and how to make the farm pay, to which the contributions of local aid added increased interest. At the close of the meeting the visiting band was divided for the night, a part returning to Mr. Willis, and a part spending the night at the house of Mr. I. C. Wight.

During the night the snow-storm changed to one of rain, which was falling abundantly the next morning, Thursday. The first meeting of that day was to be in the schoolhouse at Errol

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Bridge, nearly twenty miles away, at two o'clock, and, storm or no storm, the appointment must be met. Soon after starting the sky lightened and fair weather appeared. Recrossing the Androscoggin in the northeast part of the town, by the ferry, the party followed up its west bank for some fourteen miles to Errol. Not a single house was passed this entire distance. The clear waters of the river were on the right hand side of the road, and the primeval forest was on the left. A jam of logs filled the channel for the last two miles, which the last spring's floods had not carried out. This drive was said to measure fourteen million feet. Used to large stories, our agriculturists expanded their throats to the utmost and swallowed as much of this one as they could without choking. The upper end of the jam marked the termination of the morning's ride. That the sturdy form and cheery face of Mr. Luman H. Grover, the landlord of the comfortable little inn, was a welcome sight, admits of no kind of doubt. But the power behind the throne, manifested a little later in the dining-room, gave ample proof that it takes two to run a good hotel, and that the veiled partner is fully as important to the hungry wayfarer as the visible one. Mrs. Grover fairly earned the unbounded gratitude of at least three hungry pilgrims that day.

The afternoon meeting was held at the appointed hour and place. It was the smallest of the series, for the rain had again set in, and it took the form of a familiar farmers' conference. Mr. Whittemore spoke first and was followed by the secretary, who detailed at some length the forms of English social life as contrasted with our own. Mr. Walker, who had choked a little in swallowing the story of the fourteen million drive of logs, finding himself in the heart of a lumber country, spoke, as he had time, upon the Southern pine (*Pinus Australis*), now brought in considerable quantities to New Hampshire, a tree as common on the great sand belt which skirts the Atlantic coast from Southern Virginia to Florida and that of the Gulf on to the Mississippi River, as is the spruce in Coös county.

The Board's representatives proceeded at the close of this meeting to the house of Mr. John Akers, in the northwest part of the town, where they were bountifully entertained. An

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evening meeting, held in a schoolhouse about a mile distant, was well attended. After remarks by Mr. Whittemore, the secretary discussed the subject of animal foods, and Mr. Walker called attention to oats and oat culture.

The next morning, Friday, the party left the large establishment of Mr. Akers, satisfied that his heart was as big as his house. The only grudge borne him was by the writer of this report, to whom he had shown a pair of steers larger and finer than his own.

The next appointment was for the evening of this day, at Stratford Hollow, forty odd miles away. A snow-storm greeted the lecturers as they reached the summit in Dixville Notch, which continued through the day. The noonday meal was taken at the house of Messrs. Asa and Samuel T. Noyes, of Colebrook, two of the best farmers in New Hampshire. A brief call, subsequently, at the house of the Coös member, made a pleasant break in the long drive of the afternoon and early evening. It was evident, when at four o'clock the party reached Colebrook village, that the howling storm and fast accumulating snow made it impossible to reach Stratford Hollow in season for the meeting, and it was accordingly cancelled by telegraph. But it was the only one missed during a week when it snowed or rained three days out of five.

MEETING AT WEBSTER.

The next meeting under the auspices of the Board was held at Webster, November 23, which was a severely stormy day. James L. Gerrish, of Webster, reported this meeting for the "People and Patriot," and we publish his report in full.

Members of the Board, who had accepted an invitation from Daniel Webster Grange, made their appearance at Grange Hall promptly, in the persons of the chairman and secretary, supported by Joseph B. Walker, of Concord, who rendered them a good service in the meeting, although he claimed to be only a drafted man. A fair number of farmers with their wives and daughters were present, although the weather was severe. Chairman Humphrey opened the meeting with remarks covering con-

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siderable ground, so that those following had liberty in choosing from the various propositions touched in his opening address.

CHAIRMAN HUMPHREY'S REMARKS.

He said there had been great changes in methods in agriculture in the last half century. There were great improvements both North and South, as a matter of necessity, as the country grew older and the original soils became exhausted from continuous cropping. Formerly attention was riveted on how to destroy the original forests and construct the necessary fences and farm buildings. To-day it is different; now successful farming is the result of thought and study. Those are not blest the most who are born with abundant means, but rather necessity and the hard knocks incident to the pursuit of agriculture in New Hampshire have developed and brought out the sterling qualities of our men. The introduction of machinery has made necessary great improvement in our farms, otherwise machines could not be profitably used. He referred to the old Dutch plow, and the wooden mold boards, as compared with those used at the present time. Now the plow and harrow both may be ridden. He next spoke of the great improvement in cattle since the first fair which he attended in his younger days. The general adoption of improved machinery, stock, and methods, has been brought about by agitating and discussing these things. The same is true in the profitable use of fertilizers. Every farmer should be able to judge of their value, as it is not equal on all farms. Ashes were not worth using on his land, he said, while they would send to Concord for ashes to use in Rockingham county, and pay the freight above the cost. He had used coal ashes profitably on potatoes, using one half a shovelful to the hill. He touched upon the improvements in haying implements, and the time and expense saved by handling less than formerly, when two or three days were required for drying it. He advocated raising corn on all lands not adapted to grass. He had advocated corn raising for New Hampshire more than any other member of the Board, and was glad to see that many farmers now planted large areas. He estimated the fodder to be worth more than the hay crop,

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on bound-out fields, and advised to turn them over and plant to corn whenever the grass commenced to fail. Great improvement had also been made in milk production by the introduction of new methods of curing corn fodder. He had made the feeding of it profitable before the silo was introduced, having learned from Prof. Sanborn how to use cotton-seed meal and other concentrated food with it. But now the light soils on all farms might be used for raising ensilage, as he had no doubt of its value. Large quantities of fodder could thus be raised, which would in turn increase the amount of dressing with which to bring up the grass product in the quickest and easiest manner. All who try ensilage tell the same story, and he had no doubt of its value.

After the above remarks, the chairman introduced Mr. Walker.

REMARKS BY MR. WALKER.

He commenced by saying that he was a farmer. His ancestors for seven or eight generations were farmers. Some would say that farming was at present at a low ebb. He did not hold that view, for ebb tide was when the sea was at its lowest. He thought the tide was rising a little compared with our past experience. Notwithstanding there were some discouragements, he thought it might improve still more. He acknowledged that there were farms abandoned, and possibly some growing up to bushes, but there could be found reasons for this state of things. It was acknowledged that there was a penalty attached to moral law breaking, and he believed that agricultural sins had a penalty as well.

If the farmer carries off and sells his crops year by year, returning nothing, it is an agricultural sin and the farm would certainly run down in consequence. If Mr. Burbank, who manufactures lumber, should say that lumber was selling low and he thought he would not do much, we should say he showed a lack of enterprise. That very thing, the lack of enterprise, is another agricultural sin and the penalty must follow. Here Mr. Walker gave a description of one of these enterprise-lacking farmers, and his surroundings, which he saw not long since in passing through

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one of the towns in Merrimack county, saying at the close of his description that there was an advertisement stating that that farm was for sale. He thought that the farm ought to be sold and pass from the one who occupied it into thriftier hands. He said that he was farming better than formerly; he plowed his land oftener. The ground should be turned over and pulverized. He believed that another sin was in not half taking care of our farms. He related an anecdote showing how he had once been reproved for insufficient cultivation by the late John Moore, an agricultural writer of some note.

Still another sin which we are guilty of is too light manuring. In 1870 there was, according to the census, only one animal kept to each four acres of land in New Hampshire. What kind of a crop could a man expect from a 40 or 100 acre farm at this rate? There was still another thing which he would mention, although he would hardly call it a sin, it was rather a bugbear; that was the failure to employ sufficient help.

The farmer will say, because wages are high, "I cannot hire, no, no, I cannot afford it! This has been growing worse and worse from year to year and I guess I will cut the grass and get along as well as I can." And so the farm grows up to bushes. Now, as farmers, are we willing to be convinced of our sins? If not, we are agriculturally lost. This is what we must come to as tillers of the soil unless we "repent, and bring forth fruits meet for repentance." We must not only "right about" but right about and then go ahead. Poor culture will not do. We must run the plow four times as much and then pulverize the soil, thus developing plant food which is locked up in the earth waiting to be liberated.

If man is willing to work in conjunction with the Almighty, He will reward his labors, but we are required to do our part by thorough culture, and by returning something to the soil. When man was doomed to labor and sweat, it was called a curse, but after all it was indeed a blessing entailed.

Old Jethro Tull, in England, was at least half right, if not more, when he thought he had discovered the key to success in thoroughly pulverizing the soil, which he claimed was all that was necessary. Suitable implements were now made for a

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thorough pulverization of the soil, and he could get as much for a day's work as formerly, on this account, although wages were higher. He believed in buying superphosphates and special manures in order to get on a good footing, agriculturally; but not afterwards as a main reliance. Meat and other substantials are required for making muscle. Superphosphates may be compared to sweet cake in our diet. They should not be the regular thing in our farming. Bring back the stocks of cattle kept on our farms in former years and use their manure for enriching them.

Farmers in some instances could exchange the raw products for manure; this was not the rule, but the exception. Those remote from market could not haul stable manure to their farms, but must feed the hay to stock and thus make the dressing for their land. He related conversation had with an English farmer who said he never did work with a man that a horse could do just as well. By observing this maxim he could get as much done for a dollar by the increased use of machinery, although the price of labor was about a third higher.

While much disappointment results from employing irresponsible laborers, horses and machinery can be depended on. Improved machinery made it even possible to dispense with a large amount of brute force. Where it formerly required eight oxen to break up the witch grass lands on his farm it could be done now with the sulky and three horses, requiring only one man instead of three or four. He mentioned a list of plows which had been in use on his farm, but said they had all been superseded by better implements with great saving of labor per acre in working the soil. What we needed was more knowledge and faith in our calling. More knowledge resulted from increased thought and application.

Secretary Adams addressed the audience, commencing on poultry, as the subject had been suggested by the reading of a notice of the New Hampshire Poultry Association at Concord.

REMARKS BY SECRETARY ADAMS.

A love for the business was the first requisite to success. One thing which recommended the business was the fact that those

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who were not classed as able-bodied men might engage in it, also the women and children. Poultry and eggs, when sold, do not carry away from the farm much valuable plant food, while milk reduces the phosphoric acid, without which the seed and kernel cannot be matured. If milk is sold directly, grain must be bought with which to restore the loss of fertility, whereas, there is little loss in selling butter or cream, retaining the balance. No kind of grease will increase vegetation to any extent. Oats, clover, and corn stalks properly enter into the organization and growth of all young animals. If anything be sold from the farm, it is better to sell corn than hay, as each ton takes $6.00 cash value from the soil. He illustrated by relating conversation had with those who have sold hay to their hurt. He advocated growing clover hay and feeding it out on the farm. The English people get the best wheat following clover, as its roots pump up nitrogen and fit the soil for that crop. Peas and beans are good crops to grow, and to purchase for cattle food when prices rule low. Fertilization must be induced by the rotation of crops in some cases, as there is a limit to the profitable use of mineral manures unless this is done or vegetable matter in some way applied.

At the suggestion of W. W. Burbank, master of the Grange, thanks were voted the Board and Mr. Walker for the effort they had made in coming, and for their interesting and instructive entertainment. This was made unanimous by a rising vote. The ladies of the Grange had, during the exercises, prepared suitable refreshments in the anteroom to which all were invited at the close of the meeting.

MEETING AT WILTON.

The Wilton meeting, held December 16, had been well advertised and all arrangements made for a successful meeting, but the severe storm of the day prevented a large attendance. Even the speakers were unable to be present and Secretary Adams with the farmers and milk producers of the immediate vicinity occupied the forenoon in a discussion on feeding for the production of milk. Prof. Babcock, the milk inspector from Boston, arrived on the afternoon train and addressed the audience in a highly in-

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structive manner. Remarks on various features of the milk business were made by Messrs. Whiting, who have built up a large and permanent business in the village of Wilton, in milk and dairy products. Although the attendance was small there was a marked interest in the subjects under consideration, and doubtless good results will follow.

MEETINGS AT JAFFREY AND FITZWILLIAM.

A meeting was held at Union Hall, East Jaffrey, January 4, and at the forenoon session the Board was represented by J. S. Perry, of Rindge, member from Cheshire county, George S. Philbrick, of Tilton, member from Belknap county, and Secretary Adams. The time was occupied with general remarks. There was an increased attendance at the afternoon session and the talking force was increased by Joseph Farnum, of Peterborough, member from Hillsborough county.

Mr. Perry presided and gave an interesting account of his experiments with commercial fertilizers and their application, and his method of conducting farm operations generally, throwing out many valuable hints and suggestions.

He was followed by Mr. Farnum, who urged the importance and advantage to farmers of keeping more strict and systematic accounts with their fields and their animals, in order to ascertain to a certainty whether the balance is on the right side of the ledger at the end of the year. He also gave some facts and figures in relation to reclaiming bog meadows as follows:

"Drainage has become one of the most important of farm operations and is being more and more employed by the intelligent and progressive farmers throughout the country. In former times when land was cheaper and more productive than now, the necessity for drainage did not exist and land too wet for cultivation was considered as so much waste land. Now that the virgin soil has been exhausted of its power to produce large crops, except by the outlay of large sums for fertilizers, the condition of things is changed, and that which was considered waste land becomes the most valuable.

"Drainage consists in the removal of surplus water from the

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soil. Several methods are employed to accomplish this result which I will not attempt at this time to discuss but will simply give the result of an experiment in this line which has come under my observation.

"In an out-of-the-way place, on a certain farm, is a tract of several acres of wet land which, ten years ago, was sold at $1.25 per acre. It produced only the cheapest quality of meadow grass, and that only on small patches, the larger portion being coarse, rank weeds, unfit for any purpose. What was cut was largely used for bedding and had to be polled off the ground, costing all it was worth to harvest it. In 1883 the owner commenced to improve it.

"The first step was to dig ditches three feet deep, three feet wide, and thirty rods apart one way and six rods the other. This secured drainage to the depth of eighteen inches. He then removed the turf, piling it in rows or sections to require as little handling or transportation as possible. All stumps, roots, logs, and limbs that would interfere with the plow were also removed.

"One acre was treated in this way the first year at an expense of about $250. The following spring the turf removed the previous year had become well rotted and dried and was easily burned upon the ground, together with the stumps, roots, etc., removed therefrom, and the land then plowed, cultivated, and planted.

"At the same time another acre alongside was undergoing the same process of ditching. The crop raised on the acre first improved this year was principally onions which were sold for $400, with $25 income from early peas, $17.50 from early beets, and $25 from cabbages, making a total income of $467.50, besides 30 bushels of carrots and 6½ bushels of potatoes unsold. The next year 803¾ bushels of onions were raised and sold for 75 cents per bushel, $602.81; 4¾ tons of carrots were sold for $71.25; early peas, $43.50; beets, $27.67; 56 bushels of potatoes, $28; 30 bushels parsnips, $22.50; celery, $255; making a total of $1050.73, or about $350 per acre for the three acres cultivated.

"Enough of each variety of the crops raised, besides some other

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garden truck, such as green corn, cucumbers, squashes, etc., were reserved for family use and were not reckoned in the above amounts.

"The expense of cultivating after the ground was put in condition for that purpose was about $350 for the three acres, which includes the constant labor of one man eight months, one horse a portion of the time, fertilizers and seeds, and leaves a clear profit of $700, or $233.33 per acre.

"Ashes were largely used for fertilizer, with some hen manure, but chiefly home-made fertilizers compounded from the raw material were employed. This year more ashes will be used for it is believed they are the best and most economical fertilizer the market affords.

"This case is not cited as a remarkable example in this line, but simply to show what has been done in the way of improvement and securing a profit therefrom. Undoubtedly there are many such places which might be similarly improved and made to return handsome incomes to their owners."

Mr. Philbrick gave minute details of his experiments with various kinds of food for cows during the last five or six years, with a view to discover that which will give him the greatest return for the least expense. His remarks were interesting, and were made with an assurance which carried weight to his listeners. The facts presented will be published in a paper prepared by Mr. Philbrick for this report.

Mr. Adams's remarks during the afternoon were brief.

At the evening session a fair number were present and listened to Secretary Adams, on "Stock Breeding" and "Improvement of Farms." The remainder of the session was occupied in remarks by Peter Upton, Mr. Runnels, and several young farmers of the town, who manifested, by their suggestions and queries, that they were wide awake, and interested in farming. Jaffrey is a well-farmed town, with an encouraging agricultural outlook.

January 5 a meeting was held at Fitzwilliam. The weather was unfavorable, and the attendance at the afternoon and evening sessions was not large. The Board was represented by Messrs. Perry, Philbrick, and Secretary Adams. Samuel Kendall, a well-known farmer of the town, acted as chairman. In the afternoon

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the secretary gave a half-hour's talk on general topics, after which Mr. Philbrick discussed the feeding question. At the evening session Mr. Adams discussed methods of increasing the fertility of the soil, presenting as a leading thought that the farmer who would improve an exhausted farm must sell such products as bring a large return in proportion to the loss sustained by the soil in producing them. Mr. Perry followed, and urgently pressed the suggestions of the previous speaker, and gave some illustrations of the argument in practical experience.

Mr. Philbrick presented his paper upon "Specialties in Farming."

The meeting was brought to a close by remarks to and in behalf of farmers' sons, by Messrs. Perry and Adams, followed by a few words from the chairman and Hon. A. J. Blake, of the town.

MEETING AT CONCORD.

A meeting of the Board of Agriculture was held at City Hall, Concord, January 13, the day following the annual meeting of the Dairymen's Association. It was called to order by Chairman Humphrey, who, in opening remarks, alluded in brief to the means and methods for the improvement of agriculture and of the farmer's condition, mentioning specially the advance that had been made in the quality of live stock kept or raised by the farmers in the last half century, largely through the introduction of thoroughbred males. He complimented the Grange as an organization which has contributed of late to the general condition of the farmers of the country, and also alluded to the fairs as beneficial, but often being managed more for the benefit of personal and political combinations than for the good of the cause of agriculture.

He introduced, as the first speaker, Geo. H. Whitcher, superintendent of the college farm at Hanover, who proceeded, in the half-hour allotted him, to give a practical talk upon "Fertilizers."

At the conclusion of Mr. Whitcher's remarks, Hon. Mortimer Whitehead, of New Jersey, lecturer of the National Grange, was introduced, and talked earnestly and uninterruptedly for an hour and twenty minutes. He opened by expressing the pleasure he

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experienced in being permitted to address even a small gathering of intelligent New Hampshire farmers under the auspices of the State Board of Agriculture, complimented the practical and instructive talk of the gentleman who had preceded him, to which he had listened with pleasure, offered a few suggestions of his own in connection with the same subject, and then proceeded to devote his attention to the subject which he had primarily in view, and upon which he was expected to talk, the necessity of organized effort among the farmers of the country.

No mere abstract would do justice to his address, and for that, even, there is no space in this connection. It must suffice to say, that in showing what the Grange has already accomplished in the way of bringing the farmers of the country into community of thought and unity of action, and the actual results already effected through such combination in promoting their welfare in matters of business and of legislation, he demonstrated the great value of the institution, and the reasonable hope for greater and grander work through its instrumentality in the future.

Hon. John D. Lyman, member of the Board from Rockingham county, was the first speaker in the afternoon. He gave a practical talk on "Forestry," which subject he has given thorough investigation, and his address contained valuable statistics and facts.

Mrs. A. G. Marshall, of Dunbarton, followed with a poem entitled "Rural Jingles." The production was meritorious and well received. Hon. Edward Burnett, of Southborough, Mass., delivered an address upon the Channel Islands and it is regretted that it cannot be given in full. We print the following abstract as reported to the "People and Patriot" by Mr. Gerrish of Webster:

THE CHANNEL ISLANDS.

Having visited these islands yearly for the last four or five years, I purpose to give an account of them much the same as though I had dropped into a neighbor's and was relating my experience in a familiar talk.

The railroads arrive at and leave London much like spokes in the hub of a wheel. Taking the Southeastern, the traveler

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reaches Southampton in about three hours. The strong docks at Southampton, which is a large seaport, are wonderful works, and so strong that those of our seaports look puny in comparison. Those of Liverpool and St. Heliers are somewhat similar; although in the British Channel the islands are really not so very near to England, being only twelve miles from the French coast, and 125 from England.

Navigation in ordinary weather in the British Channel is uncomfortable, to say the least, and once out of the ten times we have crossed the channel the weather, to use the English expression, was especially nasty. On account of the roughness of the sea small iron steamers of about a hundred tons' burden are used. The islands in order of their size are Jersey, Guernsey, Alderney, Sark, and Hern. About 100 miles out we pass Guernsey and Alderney, the most noticeable thing being the high sea-wall built out to assist navigation. These are built of solid blocks of granite. One is next much impressed with the beautiful flowers — camellias and roses — which grow in the open air with little care.

Arriving at Peter's Port, to leave the mails, we notice the massive sea-wall extending out to sea a long distance. These massive walls of granite, ironed together, extend also around the shore, with an esplanade on which the carriages and trucks drive, with occasional turnouts. The tide in these bays runs forty feet high; consequently the stairway landings leading to the driveway are three stories high. The accommodations on the steamers are poor, and the delicious fruits displayed on the shore are very tempting after such a rough passage in the autumn months. These fruits are sold by women, who sell them from baskets, both plums and grapes.

The Island of Jersey is twelve miles long and five wide, St. Heliers being the seaport. We see docks, locks, and a sea-wall, inclosing twenty acres of water. These superb works of granite cost $15,000,000. Trade being free here, the harbor dues are the only means of support. They amount to from $75 to $150 a trip to packets, making an essential element in figuring the profits of a voyage.

The Island of Jersey has thirteen parishes, the language spoken here being the pure French of the eleventh century, that now spoken in France being the dialect.

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Around the old part of St. Heliers are drives on top of the quaint old wall, wide enough for a single track only, turnouts being made once in fifty yards or so, where the drivers stop and utter a loud and peculiar cry sounding like "wi la"— which means turnout. King's street has a narrow sidewalk of not more than fifteen or twenty inches, although the principal street.

Here are displayed various wares of mottled granite. Foreign venders come here to meet the tourists from England and Scotland, who linger for months in this charming spot. Tourists from other places may also be found here. The several parishes are like the towns in a country. Here rural and agricultural pursuits are carried on, and the neatness and economy are striking, every inch of land being utilized. The roads are macadamized and solid, the law governing the width of wheel used on them. The sides of the road are clean kept, the grass running quite to the walls or hedges. The houses are mostly of stone, with either thatch or tiling for roof. House, stable, and greenhouse are nestled together, the greenhouse and the grapes being in care of the mother, and the proceeds of sales belonging to her. Muscat, Hamburg, and Sweetwater grapes are delicious and, with the potatoes raised here, have a reputation equal to that of the cattle. The grapery and greenhouse are surrounded with flowers, the whole wearing a cheerful aspect.

The cows are as much thought of as though members of the family. The women tether and care for them. They seldom wander loose, but are fastened with a rope, an iron pin being driven into the ground, which is moved by the women in charge three times a day. The cows are tethered in rows, and it is a charming sight to see them mow their swath.

The farms are of but a few acres each, and are fenced with walls of earth with a path on top, the sides being covered with grass. The peasants are quaintly dressed. They wear a shawl and bodice, with short skirt. Their shoes are thick, with a heavy wooden sole, and are worn over a warm sock. The women are strong, and quiet, stay-at-home bodies, speaking only French, while all the men speak English, except when trading they will switch off and talk French with the mother about selling the cow. The fields are highly cultivated, 60,000 people

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being supported on thirty square miles, besides exports amounting to between one and two million dollars a year.

No other country supports 2,000 people to the square mile. The best lands rent for from £25 to £40, annually, per acre. This seems almost incredible, but they are highly enriched by manure and seaweed, and especially adapted to raising early potatoes, as there are streaks of warm lands.

When there is a difference of ten days or two weeks, it makes quite a difference in the price of potatoes, and suitable land rents readily for $300 an acre. The farmers rival each other in seeking the first early potatoes. A few years ago, a farmer was belated in spring on account of being away from home unavoidably; so he concluded to take his two servant girls to help him, and plant his potatoes with the sprouts uppermost. Although behind his neighbors he gained 20 days and came out ahead of them. They plant their potatoes very close, and raise by hand labor wholly. This man's experiment changed the whole business of early potato raising on the island. They now leave two sprouts on the end of the potato and sprout them sitting up on end in crates placed in a warm place. The average yield is five or six hundred bushels per acre, often selling for $2.50 a bushel. In St. Mary's and St. Owen's and other parishes this is practiced. The crop is planted in February and harvested in June.

The cattle of the island are fed at the stable in winter and nothing is lacking in care. They are fed large quantities of roots, mostly the parsnip, sliced and sprinkled over with linseed oil cake. The rainy season is in February and March, April and May being dry months. Cabbages, cauliflowers and broccoli are raised, the latter being as common on the table as the potato. I was favorably impressed with the care which the young stock received. They never lose their thrift. The calves are turned to grass at eight weeks, but their milk is not dropped. They have small feeds of milk and often. Overdoses are as bad for calves as the feeding of cold milk. A calf will soon learn to be a glutton and he will become like a syringe. After going out of doors the calves have oatmeal gradually mixed with their milk.

Coal is used for fuel on the island, and the little wood used is

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raised in hedges by the roadside, and otherwise, as they plant quick-growing shrubs which are cut and carried to the shed in bundles. When a tree blows down, its several parts are sold at auction for wood and timber, by the authorities. They are a thrifty and economical people. The little timber used in roofing their stone houses is mostly brought from New Brunswick, rafters being only 1¼x4 inches, supporting the straw roofs. The property, after the old feudal system, runs from the father to the oldest son.

It is extremely difficult for a stranger to buy land among this thrifty, but still unenterprising, people. They plow their small fields with such plows as we laid aside fifty years ago, using one horse in front of the other. The horses are Normans, and are handsome and strong. They mow either by hand or with a sickle. Their harrows, however, are good — the improved English chain harrows. Their standard snperphosphates are of high grade, and their fertilizer laws strict, a fine of $500 being imposed if not up to the standard.

They sow nitrate of soda on the grass, and, with their heavy dews and frequent showers, its influence is immediately apparent. The flowers and flowering trees are much to be praised, magnolia and tulip trees being large. A friend picked 60 varieties of wild flowers in a single afternoon.

The Jerseyman is shrewd, and if you buy you are expected to partake of the hospitalities of the house, and they seem offended if you do not. You may bind the bargain with a glass of milk, or, if you prefer wine or brandy, you can have it. In buying fifteen or twenty heifers I preferred to drink the milk and take bunches of beautiful Hamburg grapes, which I did until my buggy was well filled with bunches on the bottom.

The speaker gave an account of his experience in buying cows and bulls which was very interesting. They seldom use a bull on the island after he is three years old, as the women mostly care for them and they do not wish them to get cross and dangerous. It is about fifty-three years since the first cattle were imported. He did not approve of breeding for color or pedigree alone, but wished for a strong constitution. Jerseymen were now breeding from butter cows. Cows were sent to Eng-

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land as early as 1825. These were shipped from the Alderney Island, although there probably were not a hundred cattle there. They were brought from both islands, but mostly from Guernsey. In either case the first cattle sent from there were called Alderneys. The Guernseys are larger than the Jerseys but not as uniformly bred. Their butter surpasses everything for color, although it is thought not to be quite as solid as that of the Jersey. Guernsey breeders on the island have not been sufficiently particular about selecting bulls, but are breeding better of late years. Guernsey, as well as Jersey, is also a wonder on account of its vegetables and flowers.

Prof. C. H. Pettee, of the Agricultural College, made remarks, and the meeting was closed.

SPECIAL MEETING AT CONCORD.

A special meeting was held at the office of the Board of Agriculture, State House, Concord, February 23, and called to order by Hon. Moses Humphrey, chairman. Present, Messrs. Mason, Lyman, Philbrick, Parker, Carr, Whittemore, DeMeritte, Perry, and Farnum, comprising the full Board. On motion of Mr. Philbrick, Mr. Farnum was elected secretary *pro tem.* Chairman Humphrey stated that the object of the meeting was to appoint a secretary to fill the vacancy occasioned by the death of James O. Adams, and for the transaction of such other business as might properly come before the meeting. Mr. Mason referred to the late secretary in a feeling and appropriate manner and offered the following resolutions which were unanimously adopted:

WHEREAS, In view of the loss we have sustained in the decease of our friend, associate, and the efficient secretary of this Board, Hon. James O. Adams, and in view of the great loss sustained by the farming interests and public at large, therefore

Resolved, That we are only doing justice to the memory of the deceased in saying, that in his removal from our midst we sincerely mourn for one who well deserved our respect and regard. A genial friend, kind and affectionate associate, efficient and thorough officer, he deserved and sustained the entire confidence of this Board through the long term which he officiated as secretary.

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Resolved, That the family of the deceased have our sympathetic condolence in their severe affliction, and we commend them to Him who never errs in His dispensations.

Resolved, That these resolutions be entered on the records of this Board and that a copy be sent by the secretary to the family of the deceased, and to the local papers for publication.

By unanimous consent Rev. A. C. Hardy, a member of Capital Grange No. 113, of Concord, presented resolutions from that Grange recommending Nahum J. Bachelder, secretary of the State Grange, for the position of secretary of the Board of Agriculture and made brief remarks in support of the resolutions. Members of the Board and other gentlemen present made remarks in regard to the election of secretary, after which a ballot was taken and Nahum J. Bachelder was declared elected. Mr. Bachelder was introduced and made brief remarks in acceptance, and the oath of office was duly administered by Mr. Mason, of the Board. Voted that the secretary commence his duties March 1. A. R. Ayers, of Concord, expressed the thanks of the Grange for the courtesy which had been shown them. No further business appearing the meeting was adjourned to the call of the secretary.

SECOND ANNUAL MEETING OF THE GRANITE STATE DAIRYMEN'S ASSOCIATION.

The second annual meeting of the Granite State Dairymen's Association was held in the city of Manchester, January 12 and 13, 1886. The meeting was called to order by the president, J. M. Connor, of Hopkinton, who delivered the following opening address:

PRESIDENT'S ANNUAL ADDRESS.

Gentlemen of the Granite State Dairymen's Association:—

We are assembled at this second annual session of the Granite State Dairymen's Association to consider the butter, cheese, and milk industry of the State. Every consideration of state pride, of individual prosperity and agricultural advancement, points to the necessity for such an organization, and that it receives the cordial advancement and substantial aid, not only of

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those who make the products of the cow in these three departments a specialty, but alike to the vender and consumer. The losses and perplexities of dealers in an inferior article are well known to the trader. Every consumer should look with favor upon an organization which seeks to promote this industry, to improve the quality and quantity of these articles of universal consumption, and to open and expose the frauds and imitations now so universally afloat upon the markets, and pave the way whereby producer and consumer may be brought nearer together, and confidence restored by the manufacture and sale of none but first-class products.

The rapidly changing modes of transportation bring the vast productions of the boundless West to the very doors of the East, overcoming space and cost of transportation to a marvelous extent, thus bringing the Eastern farmer into a relation little dreamed of a few years ago. Wholesale houses are being established in every city and town of importance in this Eastern section, for the sale of beef, pork, and mutton, slaughtered 2,000 miles westward upon the plains and mountain slopes, arriving here in better condition than the meat in the country butcher's cart which was slaughtered on his own premises. How our farmers are to stand such competition becomes a subject of great importance. The dairy industry of New Hampshire and of New England is brought into a similar condition. Maine, New Hampshire, and Vermont have 485,000 cows, or 6,000 less than the single State of Wisconsin. Iowa has 1,541,122, or double the cows kept in all the New England States. The West is rapidly adopting the improvements of the East, both of machinery and breeds of animals. These conditions are undeniable. But with the characteristic pluck and energy of our New England people shall we make no effort to maintain our standard and overcome obstacles as we have been wont to do in the past? The agitation of the dairy interest through the press, in the Grange and the Farmers' Club, has worked a decided change within a short period. The introduction of the silo, warmer and better barns, the more liberal use of grain, the introduction of improved dairy implements, with the laws they teach and enforce, also a better understanding of the laws which must be observed to insure good results in the

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manufacture of butter and cheese and the handling of milk, are the instrumentalities by which this change has been wrought. The number of good butter-makers in the vicinity of our cities and larger towns is rapidly on the increase, and dealers will tell you that they have from this class of farmers an article that cannot be excelled anywhere.

We desire again to call your attention to the making of farmers' cheese. This product commands at least 30 per cent more than that made by the associated or factory system. Here is a margin in prices that finds a parallel nowhere else in dairying, or, indeed, in any farm products. Farmers living so remote from markets as to exclude them from selling butter direct to customers, ought to turn their attention more to this important branch of dairying.

Within a very recent date several butter factories have been put in operation in our State. Scarcely a community but is now agitating the expediency of organizing in this direction.

Associated dairying should be made all the term implies, that is, each patron should be a *bona fide* owner according to the extent of his business. He will thus be more likely to improve his herd of cows, feed better, and likewise educate himself and take a deeper interest in all that concerns the establishment.

The alarming increase in the manufacture of all sorts of compounds for butter, and the possibilities in the future, place dairying in jeopardy. Some ten years ago the first patent was issued for a method of making artificial butter, but not until within three or four years has it been carried on to any great extent. Now, Chicago has become one of the largest producers of the world. It has six large firms engaged in this business, which turned out the past year more than 17,000 tons. One firm alone makes two freight carloads each day. Other large cities are also extensively engaged in this enterprise. One firm in New York made during the past year 2,000,000 pounds of butterine. In Boston, Mass., Providence and Pawtucket, R. I., and other Eastern cities, firms make it by the million pounds. Hon. Norman J. Colman, commissioner of agriculture, is making strenuous efforts to collect not only dairy statistics of the country, but also to lay bare the enormity of this traffic in imitation butter, and as a practical

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agriculturist whose sympathies are on the side of American farmers, we look to him for some recommendation as a solution of this grave matter. Laws have been enacted in many States to stamp out or punish fraudulent sales of these compounds, but as yet they have had little or no effect. So long as a large per cent of dairy butter is of inferior quality and decidedly distasteful, unquestionably inferior in every way to the better grades of imitation butters, it does not behoove butter-makers to ask protection against what they characterize as unwholesome compounds. Public opinion will never enforce laws against this to protect an industry brought into such disrepute.

A vital question for us to consider at this session is, how to make this association a power in the State, how to enlist the sympathy and co-operation of progressive dairymen, how to bring our best thoughts and experiences into tangible form, so that we and others who are looking for some guide and advice may be profited thereby. I would suggest that some of the leading subjects connected with dairying be made a matter of assignment to different individuals and, with the year before them for preparation and experiment, report at the next annual session. Allow me to suggest some of the themes for assignment:

1. Best breeds of cows for the three departments, butter, cheese, and milk.

2. Best methods of feeding for these departments.

3. Value of the silo in the production of butter, cheese, and milk.

4. How far may soiling be profitably employed in the management of cows?

5. Best method of making butter.

6. How to make farmers' cheese, and why more attention should be given to this branch of dairying.

7. Milk: best methods to produce it, and why sell whole milk in preference to making butter and cheese.

These and kindred subjects might be assigned to different persons, and by having time to deliberate and gather facts much useful knowledge might be obtained. We affirm, as our opinion, that as good butter and cheese can be made in the Granite State

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as in any other. If our pasturage is inferior in some localities, the deficiency must be supplied by grain or soiling, and it can be done with a profit. We also affirm that just as good butter and cheese can be made by individual dairy, no matter if not more than three cows, as can be made at the creamery with all its appliances. Rules of cleanliness, laws of temperature, all the details from first to last, must be as strictly obeyed in the one as the other, and they may be in the former as well as the latter.

Let us endeavor to put this industry, the most delicate, the most profitable, and the best calculated to restore fertility to our soils, upon a better basis. Let us work and labor together for self-advancement, and at the same time keep in view the broader philanthropy, that helpful spirit, which would make two blades of grass grow where but one grew before.

On motion of J. O. Adams a committee was appointed to consider suggestions made in President Connor's address, as follows: Messrs. Rossiter, of Claremont, Rollins, of Bedford, Gerrish, of Webster, Waterhouse, of Epsom, and Tallant, of East Concord.

The reading of the by-laws was called for and an invitation was extended for memberships, the secretary saying that every member would be entitled to a report of the proceedings.

Mr. Waterhouse moved that a committee of five be appointed to report a list of officers for the year, which was appointed as follows: Messrs. Carr, of Haverhill, Humphrey, of Concord, Locke, of Barrington, Parker, of Merrimack, and Philbrick, of Tilton.

Afternoon Session.

The treasurer's report was read and accepted, showing a small balance in the treasury. Secretary Adams also read a report covering all the meetings held during the past year. The committee appointed for the purpose reported the following list of officers of the association: President, J. M. Connor, of Hopkinton; secretary, J. O. Adams, Boscawen; treasurer, Charles N. Clough, Canterbury; vice-presidents, I. W. Springfield, Rochester, and George B. Williams, Walpole; trustees, Strafford county, C. H. Waterhouse, Barrington; Sullivan county, P. M.

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Rossiter, Claremont; Rockingham county, Charles H. Hayes, Portsmouth; Hillsborough county, J. T. Burns, Milford; Cheshire county, S. W. Buffum, Winchester; Merrimack county, J. L. Gerrish, Webster; Belknap county, Thomas Grantham, Centre Harbor; Carroll county, Dr. Alonzo Towle, Freedom; Grafton county, J. E. Carr, Haverhill; Coös county, L. T. Hazen, Whitefield.

Secretary Adams read a paper from F. F. Fisk, of Webster, touching upon the influence of climate and food on the quality of butter, and the necessity of guarding pure butter by legislation regarding adulterations, querying whether coloring matter should be considered an adulteration. Mr. Waterhouse moved that a committee of three be nominated to confer with our representatives in Congress on this subject, which motion was adopted.

The committee on assignment of topics for the next meeting reported as follows:

Best Breeds and Feeds.—L. T. Hazen, Whitefield; J. G. Tallant, East Concord; F. F. Fisk, Webster.

Value of the Silo.— D. H. Goodell, Antrim; W. F. Daniell, Franklin; J. T. Burns, Milford.

Soiling.— R. M. Rollins, Bedford; S. C. Ham, Barrington; Jason T. Burns, Milford.

Butter and Cheese.— C. H. Waterhouse, Barrington; J. M. Connor, Hopkinton; George B. Williams, Walpole.

Milk.— Charles H. Hayes, Portsmouth; P. M. Rossiter, Claremont; Charles N. Clough, Canterbury.

A good deal of discussion arose on adulterations, after the committee's report was read, Messrs. Humphrey, Carr, Adams, Waterhouse, Kimball of Bellows Falls, Whittier of Raymond, and others, bringing out the several temptations, to dealers, and methods of fraud. Mr. Humphrey thought dealers made more money on this than on good products and said it would be easier to legislate than to enforce laws, the same as in the liquor traffic, and other adulterated articles. An instance was related of butter in prints used to incase a miserable compound, which was apparent on cutting the print open.

Mr. Goodell had no doubt that cleanliness was observed in

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the bogus butter factories and that it was better than some real butter that was offered; nevertheless, if injurious compounds were used in its manufacture it should be condemned and suppressed if possible. The "bogus butter" talk was long and interesting but the bulk is omitted for want of space.

Prof. Pettee, of Hanover, was called and made some remarks about the inability to make winter butter with sufficient color. Mr. Gerrish said he was able to make good colored butter in winter, and never colored but one churning. All that was necessary was the right breed, well weeded as to individuals, and good feed. President Connor said that this was possible, and it was something we had got to come up to in our practice. He knew that Mr. Barnard, of Hopkinton, could do it with his herd of cows. He had sufficient proof of it.

Mr. Tallant thought these experience meetings and the improvement got from the impetus thus gained would be surer than any legislative aid. He believed that Mr. Fisk was right when he said that the best butter would not keep well. He believed that butter began to "go back" in a day or two after it was made. Bogus manufacturers could not improve on a first-class article.

Mr. Tallant made some interesting remarks about the care of Jersey cattle. He expressed doubts about telling the kind of butter a cow would make by the color of skin, and many of the tested Jerseys had poor escutcheons.

Mr. Riddle, of Manchester, thought if all bogus butter was taken at once from the market there would be a butter famine. He deplored that there was so much poor real butter made in New Hampshire.

The president said, in closing the discussion for the afternoon, that there were adulterations in woolen goods, leather, etc., and now we had got it in butter. We have got this to pass through in our dairy history, and no one can predict where it will land us.

Evening Session.

The first speaker was Hon. D. H. Goodell, of Antrim, who spoke of the changed condition of agriculture and mechanics

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from the old-time standpoint. He spoke of the Jersey and Holstein cattle as dairy animals and producers of milk, and the capacity of the Holstein for standing a continuous test as compared with Jerseys, which brought Mr. Tallant to his feet to defend the Jerseys, citing "living witnesses" that had survived the heavy feeding. Mr. Goodell continued in defense of the larger breed, and said he had known small men, cows, and horses, that consumed as much as larger ones. He spoke favorably of ensilage; didn't know but it might be a good way for some farmers to pluck off the ripest ears and put the remainder in the silo.

So much was said at this meeting concerning methods of putting in, weighing, and feeding ensilage, that we can make little use of the matter with the expectation of giving much that is new, except that it is gaining in favor, that it may be put in either whole or cut and much slower than formerly was supposed, that the covering of plank may be omitted, provided a foot or more of bog hay can be put on top, and sand or loam used for weighting, at a depth of from one to three feet, which is removed and used for bedding and absorbent in the stable. Also that mature corn makes the best ensilage and frost-bitten the poorest. We cannot do justice to the various gentlemen that we should be glad to name in connection with this matter of ensilage talk, having so much matter at the different sessions to condense.

The treasurer thought he was better off to raise twenty-five or thirty acres of field corn than a less number of ensilage with the same amount of manure. Mr. Hazen, of Whitefield, gave some very interesting figures, judging 350 tons, raised at a cost of $399, to be equivalent to 150 tons of good hay. His cows gained from 50 to 80 pounds of milk a day, on commencing to feed it to some more than 100 cows. Mr. Hazen showed good ensilage and grain butter made from farrow cows having no hay feed. Butter was shown, also, by Messrs. Waterhouse, Rollins, Barrett, and the Gerrish Brothers, and dairy cheese by Mr. Carr.

SECOND DAY.

The day opened colder than Tuesday, but there was a fair attendance and a large amount of talk, full of meat for those

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present. Mr. Connor announced Messrs. Adams, Daniell, and Hazen, as the committee nominated as per yesterday's resolution to confer with congressmen.

Mr. Carr introduced the following resolution which was adopted: "Whereas, large quantities of imitation butter have been sold in this State, and as said compounds are deleterious to health and damaging to the dairy interests, therefore resolved by the Granite State Dairymen's Association that thanks are due to the author of the 'pink butter bill' and to the Legislature for passing the same, it giving evidence to the sight so that the imitation butter can be easily detected."

Mr. H. K. Slayton, of Manchester, spoke at length on what he had learned of the oleomargarine trade. It was damaging to dairy interests to have oleomargarine and butterine sold at low figures, and it was perfectly competent for our Legislature to pass laws to protect the health of our population. He knew that the grease carts picked up stuff and extracted the oleomargarine oil and sold it for about seventy cents a gallon. He would not say where this oil went, but all the large cities manufactured bogus butter and sold it to boarding-house keepers and others. It was even mixed in different proportions with creamery butter. Hucksters and shysters would peddle it and make money at it. Evidence for detection by the sight was good, and our Legislature hit the nail right on the head. If every State would adopt it, one hundred and fifty million pounds less of the stuff would be manufactured yearly. Even cheese was adulterated with lard, which was damaging to our foreign trade.

His Excellency Governor Currier came in during the forenoon, and was introduced, and spoke briefly on the agricultural and mechanical interests of the State.

Mr. Hazen thought agitation might do more against the bogus butter business than legislation. The constitutionality of the bill before cited was discussed, Mr. Hills, of Plaistow, and others, expressing doubts, which were quieted by a remark from the governor, regarding his knowledge and opinion on the subject, which was received with applause. He thinks the law will stand the test of the courts.

During the forenoon Mr. Littlefield, city inspector of milk,

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came in and kindly made an analysis of a sample of milk just taken from one of the carts on the street, with instruments used by inspectors, which produced an interesting talk on milk and skimmed milk.

Afternoon Session.

In the afternoon a promiscuous talk was enjoyed after the formal discussion of "Cheese Interests." Mr. Gerrish said he had acquired a taste for cheese made from the Channel Island cattle, and Mr. O. H. Leavitt, of Manchester, said that the Winthrop (Maine) factory took first prizes for cheese, made from Jersey cattle. They had continued to make and sell it successfully for the last eleven years. S. C. Ham, of Barrington, spoke in an interesting way of his butter business, having made about 5,000 pounds the last year, from an average of sixteen or seventeen cows. He and Mr. Hills also gave their experience in soiling.

Mr. Hills had one cow which had not been to grass for six or seven years. He soils with grass, followed with Hungarian and rye. A committee was appointed, consisting of Messrs. Hazen, Rollins of Bedford, Gerrish, Waterhouse and Barrett of Concord, to confer with the officers of the New Hampshire Agricultural Society concerning premiums to be offered at the next fair.

THIRD ANNUAL MEETING.

The third annual meeting of the Dairymen's Association was held at City Hall, Concord, January 11 and 12, 1887. There was a fair attendance of leading dairymen of the State, and also several gentlemen representing the Poultry Association, who were holding their first annual meeting at Phenix Hall.

President J. M. Connor, of Hopkinton, called the meeting to order and delivered the following address:

PRESIDENT'S ANNUAL ADDRESS.

Gentlemen of the Association:

We are assembled in annual session, organized under the title of the "Granite State Dairymen's Association," to consult

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together how best to develop and make profitable this important and most intricate branch of New Hampshire farming. Dairying has not assumed the proportions in our State that exist in many others, yet the progress which marks its development within a recent period warrants the belief that it is just in its infancy, and the marked success attending those who have given proper thought to all the details required, and adopted methods which are indispensable to success, warrants the belief that it may be so enlarged and improved upon as to place New Hampshire among the front ranks in the dairy column.

There are men to be found in every town in the State who have as clear a conception of methods of breeding and feeding, of all details required for successfully conducting the production of butter, cheese, and milk, as can be found anywhere. What is required to strengthen all such, to aid those who may be struggling for light and knowledge, is organized effort. This must not be lost sight of. Whoever ignores the importance of organization strikes at the very root of progress. It may cost a little time and money, but to the individual and the community it is always a safe and sure investment. He that has any state pride, or any regard for his own pecuniary and intelligent advancement, cannot ignore this position.

RESTORING THE FERTILITY OF OUR FARMS.

We believe the position cannot be controverted, that the making of butter, and, as an accompaniment, the raising of pork, are the best means yet devised to restore lost fertility. Sheep and all young stock need a large amount of exercise in summer, so that pasturage seems indispensable, but with cows, while good pasturage is very desirable, yet success has attended many of our best butter-makers who place but little reliance upon the pasture. The restoration and improvement of our tillage land is a problem all are trying to solve. We doubt if commercial fertilizers can be relied upon to accomplish this result. They are to the soil what stimulants are to the human system, not reliable to build it up.

The butter from the cow, and the pork product from the hog by their side, carry but a fraction of the fertilizing elements off

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the farm, and they are the best machines kept on the farm in form of stock by which to convert foods of large fertilizing properties into the very best of manures for all kinds and conditions of plant growth. We commend these suggestions to that numerous class who are looking in search of some way out of this fertilizer problem.

THE BUTTER MARKET.

The year opens with flattering prospects for the dairy interests. Notwithstanding the enormous production of butter and cheese in our country, coupled with the immense quantity of imitation butter thrown upon the market, we start in upon the new year with a smaller surplus at all leading points than for some time past. All fears of an overproduction of good butter are groundless. We doubt if ever such a time arrives in this country. Notwithstanding the constantly increasing knowledge that is developing in the science of butter-making, the tastes of dealers and consumers keep pace with this improvement. What would pass for first-class butter ten years ago would to-day make an inferior showing. The man who never made a pound of butter or cheese in his life may be a far better judge of quality than he who has been engaged a life-time in its production.

IMITATION BUTTER.

A long and exciting contest over the frauds and imitations which have sprung into existence of a recent date, which excited fears of peril to this industry, has culminated in a law enacted by Congress placing some restrictions upon these "bogus" manufactories. While this may be the most alarming peril upon a genuine industry, we can conceive of many other branches of agriculture that are likewise in a degree of peril from adulterations and imitations. So far as the plea comes for the enactment of such a law to protect the stomachs of consumers from injurious consequences, we might cite the poisonous compounds and mixtures under the form of spirituous liquors which every candid man will acknowledge endangers the stomach, yea, the reason of our people a thousand-fold more than all the butter adulterations ever practiced, over which Congress might throw out its cautionary signals, and demand a little branding done.

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The tiller of the soil, though he may not always prepare his product for market as he ought, yet, such as it is, it comes free from adulteration. Let a guarantee be put upon all articles of wear and consumption, setting forth just what enters into their composition. The greatest good which will result from legislation relative to fraudulent butter consists in its paving the way for yet broader work to protect all classes from fraudulent mixtures, that all may know just what they are purchasing, and then as free men, with their eyes open, they are responsible for the use and consequences of what they purchase. Laws to be effectual should be enforced, and only by their enforcement can we judge of their merits or demerits. If the law of Congress above referred to is just and judicious, a commission should be established in this State, as in many others, to see to its fullest enforcement, otherwise it will become, as is too frequently the case with other salutary laws, a dead letter.

CREAMERIES.

The establishing of co-operative creameries in our State has made commendable progress of late. When placed in the hands of competent and honest men, they have proved satisfactory to patrons, and have done much to elevate the dairy interest. There ought to be many more established, especially in towns remote from a home market. It is far better to turn over the business to one skilled in making and marketing than to continue the old methods so unskillful in both these requirements.

In conclusion let me urge upon you, as the representative dairymen of our State, the importance of taking such action at this session as shall enlist, if possible, the co-operation of more interest in this important industry. Is it not possible to hold special meetings in different sections of the State? Can we not invoke state aid to a limited degree, so as to enable us to circulate printed essays upon topics of vital use in the production of butter, cheese, and milk? The main bulk of legislation is directed toward the development of resources of the State. Legislation should see to it, if its aid is to be invoked in any direction, that agriculture does not falter. The industry our organization seeks to elevate must be made the leading one or it will certainly falter.

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Treasurer Charles N. Clough, of Canterbury, reported a small balance of in the treasury.

A committee of three was appointed to nominate a board of officers and trustees for the ensuing year. The president appointed on this committee George S. Philbrick, of Tilton, Joseph Barnard, of Hopkinton, and S. C. Pattee, of Warner, who reported as follows:

President, J. M. Connor, of Hopkinton; vice-presidents, C. H. Waterhouse, of Barrington, W. F. Daniell, of Franklin; secretary, James O. Adams, of Boscawen; treasurer, Charles N. Clough, of Canterbury; trustees, George B. Williams, of Walpole, C. H. Waterhouse, of Barrington, P. M. Rossiter, of Claremont, D. H. Goodell, of Antrim, J. T. Burns, of Milford, J. L. Gerrish, of Webster, Sam. Hodgson, of Meredith, Alonzo Towle, of Freedom, John E. Carr, of North Haverhill, and L. T. Hazen, of Whitefild.

Afternoon Session.

George H. Whitcher, superintendent of the college farm, read a paper on milk, which was a scientific production, and was followed with an interesting discussion.

Mr. F. F. Fisk, of Webster, presented the following paper on "Dairy Feeding":

DAIRY FEEDING.

Within the memory of most of us the cow was an important agent in the dairy business. It was a living being, and required something to build up waste that is constant with all living beings. As the cow was endowed with animal life, it required vegetable life to sustain it. All plants contain materials for making muscle, bone, and cartilage, and to make heat and support respiration. All plants do not contain the various elements of food in the same proportion, nor are all animals alike in their requirements for the various elements of nutrition. Watching the cow, as she feeds at will, we find her cropping the blades of growing grass. Instinct is the best guide, so we feel assured that growing grass is the best food for the dairy cow. But the growing grass is a living being, and subject to the laws of change

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common to all living beings. It must be fed. Everything necessary to feed the grass is in the earth and air.

With no lack of any one of the many things earth and air furnish to the growing grass, there would be no growth without sunlight to digest the crude sap which conveyed from the earth the various elements of nutrition for the grass. While the sun shone upon the grass plant food was assimilated, and every hour the growing grass was richer in that which made it valuable as food for the dairy cow.

The sun only works from sunrise to sunset. In the night no sap is changed to plant food, but by ordinary chemical forces some of the sun's work is demolished, and the grass is not as rich in the morning as at night. Do the cows notice the difference in the quality of the grass that they are reluctant to feed in early morning? Should the day be cloudy and sunless, the grass will constantly grow poorer; its value as food for the dairy cow grows less, which is manifest in the diminished flow of milk. Hay cut immediately after a period of cloudy weather is of less value as food for dairy stock than the same grass would have been if it had been cut just before the cloudy period. I said growing grass was the best food for the cow. It would seem to be sunlight.

During the long days of June, with earth and air full of plant food, more sap is elaborated than is required to build up the fabric of the plant. The grass contains many vaults for the reception of any surplus the plant would deposit. As the deposits increase so does the value of the grass for food for the dairy cow. The proof is found in the brimming pails of milk, and rolls of golden butter.

All about the grass the buttercups and daisies flaunt their gay blossoms. The clover wastes its fragrance upon the air. The grass, finding its vaults well filled with everything life needs and more than it can use in building up its fabric, resolves to show its taste for decoration and no longer be the only undecorated plant in the field. It accordingly draws from its hoarded wealth, and spends it in a myriad of tiny blossoms. As modest as is the display it draws heavily upon its stores. The proof is shown in the undiminished flow of milk and yield of butter.

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The grass becoming alarmed at the rapid waste of its stores, and fearing bankruptcy and disgrace in the eyes of its companions, gathers its remaining stores, secures them in a grip-sack, and departs. When the cow seeks the grass again she finds it looking pale and troubled, as though some great calamity had befallen it. The first bite reveals the truth. Disgusted that the grass has robbed her of her food she crops the ragweed and golden rod, or any weed or bush, occasionally returning to the grass to make sure she was not deceived.

The cow has always been a great trouble in the dairy, and now she shows her perverseness by making milk and butter from anything she can get to eat. True, there is milk and butter. Though the quantity is much less, there is a worse trouble. It is no longer golden, like the June product, but of any conceivable shade between that and white. The cow pasture refuses to do anything to make it better. Here is trouble indeed. The June butter was sold, and the money spent. The customers refuse this butter, for it is light-colored and lacks flavor. Just now that philanthropist, the chemist, comes to our rescue, and puts into our hands a little bottle; a few drops from it will turn the whitest butter to a perfect golden hue. How we thank him from our hearts for the discovery! Let the cow persist in her willfulness, and make butter from anything she can find to eat, a drop from the bottle and the color is all right. With the color our customers recognize the flavor so much desired. We no longer need the growing grass of June. Straw, bog hay, dead cornstalks, are just as good as long as the contents of the bottle are not exhausted.

The cow was at the bottom of more trouble. The population of our country was rapidly increasing. Europe was sending thousands who did not know the taste of butter. We were anxious they should learn to enjoy the luxury; but the cow did not care if they died eating dry bread. We tried every means to induce the cow to increase her yield of butter that all might be supplied. We offered an unlimited amount of corn meal, pea meal, cottonseed meal, everything tempting if she would just make the desired amount of butter. That it was the cow's fault was certain, for once in awhile, just to show what she could do,

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she would make from twenty-five to forty pounds and more in one week. I say it was the cow's fault, for, after showing plainly what she could do, she would die before she would make butter for people who could not recognize its taste. We were in trouble again. We had boasted that we could make bread for the world, and butter it besides. Our friend, that philanthropic chemist, comes to our rescue again, and now in spite of the cow every man can lubricate his bread. Grass may be the best food for a dairy cow, but whoever tries to manage a cow dairy will find the cow will give him much trouble—the result of improper feeding.

If grass is the best food for the dairy cow, before we neglect grass for an inferior food we should learn to make as much food as possible, and then learn how to secure it when it contains the greatest food value with the least possible loss. If grass was grown as well as it might be, and properly cured and housed, no artificial coloring would be needed to make butter pleasing to the eye, and of far better quality than white butter, colored.

So closely related are the food of the cow and butter that one cannot be discussed without the other. Grass may not yield so much bulk of food per acre, but it will yield a butter that for quality cannot be exceeded by any of the various substitutes for grass. Consumers and dealers generally think all winter butter must be colored to be pleasing to the eye. Teach the consumers that the best of butter can be made in winter season and without coloring, and the few dairymen who will furnish that kind of butter will again find their goods standing higher than creamery butter that is colored. Then the dairyman who is so indifferent to his own interests as to keep his cows on dead food, and who must color his butter, will take his place in the ranks of the "oleo" men, and brand his goods "imitation."

This subject was afterwards discussed in both its practical and scientific bearings by Hon. Joseph B. Walker, of Concord, O. M. Tinkham, president of the Vermont Dairymen's Association, Messrs. Philbrick, Whitcher, and others.

Mr. L. T. Hazen, of Whitefield, read the following paper on "Creameries":

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CREAMERIES.

Mr. President, Ladies and Gentlemen:

You have doubtless seen by the posters that Messrs. Daniell and Waterhouse, and your humble servant, were to speak upon the subject of creameries. We read in the good Book of a wedding feast where the master of the house was credited with saving the best wine till the last. This custom has been handed down from generation to generation, and the managers of this association are following that example by presenting my paper first, leaving Messrs. Daniell and Waterhouse as the pure wine till the last, using what I shall say as a preface to the words of eloquence and wisdom that will soon follow. An introduction to a book gives in its preface an outline of its contents. At the dinner table the soup comes first, not so much for its intrinsic food value as an appetizer for the richer foods that are to follow. This is my position to-day. I am to furnish the poor wine and soup to create an appetite for the more solid matter that will be presented. A co-operative creamery was first organized in Rome, N. Y., by Jesse Williams, in 1851. Its origin is considered accidental by many, but I say it was providential. The circumstances under which it was organized were as follows: It was found that Mr. Williams's butter sold for a much higher price than that of his son living near, and to aid him Mr. Williams worked up his milk with his own, the expense to be shared *pro rata*, according to pounds of milk. This proved so advantageous to the son that other neighbors urged and finally persuaded him to take their milk in the same way. Mr. Williams continued to increase until finally he was working the milk of all the farmers living near him. Thus his idea of collecting the milk of several herds so that the best skill could be obtained and applied to the manufacture of the butter has been handed down and enlarged upon until creameries extend from the Atlantic to the Pacific. With such men as Professors Arnold and Alvord, R. P. McGuinney, of Illinois, Sherman, of Iowa, Daniell and Waterhouse, of New Hampshire, and many others, devoting their best talent to its study, it is not strange that great improvements are being made in the development of this popular method of handling milk.

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The vast wheat fields of the West have been cropped with wheat and corn year after year till the more energetic farmers realized that something must be done to stop the continued impoverishment of their farms or they would soon become bankrupt. With true western zeal we find such men as R. P. McGuinney, Mr. McKinstrey, and others, having heard of the success of the Williams enterprise, interesting themselves in it, and pushing it ahead until the name of "Elgin" is a familiar word not only in the households of this land but of all lands. Others took up the cry, "On with the creamery," until they were established in all parts of Wisconsin. Through the efforts of Sherman and others they were established in Iowa, and later in Minnesota. Kansas and Nebraska followed, and finally the interest rebounded into our own New England and the creamery system developed through the zeal of our enterprising men whose names are familiar to you all. I will not enumerate the creameries of New England until we have looked over our own State and considered the vast benefits they have been to us. We will consider for a moment some of the benefits of this method.

First, the improvement by changing the butter made in the several farmhouses, good, bad, and indifferent, to a uniform quality, in most instances making an improvement, and where the quality was not improved the wives and daughters were relieved from a vast amount of burden, care, and hard work.

Of the different systems in use there is a diversity of opinion in regard to the best. We will first briefly consider the whole-milk system, which is carrying the milk to the creamery, where it is run through the separator, set by the Cooley system, or by deep open setting. I will not enter into a discussion on the merits of these different systems, but I think when patrons live sufficiently near the creamery to carry the whole milk without much expense it is the most profitable. This places the entire business under the control of the butter-maker, whose reputation is at stake and who will take more pains with the milk than some farmers will at home. Whichever system is used a better quality of butter will be obtained than by the cream-gathering system. The two most popular methods are the whole milk and separator process at the factory, and the cream-gathering system where the cream has been raised by the Cooley process. It is claimed for

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the separator that from ten to fifteen per cent more butter can be made than by any other process, and that the butter is equally as good. It is claimed by some that the quality of the butter made in this way is not as good, and this remains to be determined by future tests and trials. The system by which the cream is gathered from Cooley creameries at the homes of the patrons, and the skim-milk left on the farm, would be the best system if the same high quality of butter could be obtained. This would be possible if all patrons would use the best of care with the cans and temperature, but I know by experience that they will not, therefore I advise the whole-milk system where patrons live sufficiently near to make it practicable, and in all cases I would advise having the skim-milk returned to the farm. In this way only about three per cent of the food consumed by the cows will be taken from the farm.

Another benefit derived from the creamery system is its effect upon the patrons as an educator; with no disparagement to our agricultural colleges, for I believe in, and am friendly disposed towards them, and I believe if properly patronized they would be the means of great good to our State, at the same time I believe co-operative creameries are doing more good than some of our agricultural colleges. For example, the farmers of a town may be keeping five, ten, or twenty cows each. One will get more butter or a better price with the same number of cows. It is usually conceded that he is feeding well or his wife is an extra butter-maker. Let those same farmers carry their milk to the creamery and they will find they are not getting equal cash returns and will soon commence to investigate. They will commence to ask, "How many cows have you?" And "How is it that you get so much more from the same number of cows than I do?" "How do you feed?" "What kind of cows have you got?" Such questions are being asked daily among the patrons of my creamery, resulting in weeding out the poorer cows and keeping the best ones, a better system of care and feed and a better general system of farming being adopted. They are led to take and read more agricultural papers, note the experiences of others, and, in a measure, pattern after them, resulting in better farmers, better husbands, better fathers, and better citizens.

Another source of improvement is for the managers of cream-

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eries to point out the defects in the cream or milk, explain the cause and the remedy; and in ninty-nine cases in a hundred they will try to remedy the defects. In making the effort they will soon become interested in watching for and guarding against them.

In these various ways the creamery can be made, and in many cases already is, a dairy school, yes, more, a general educator, elevating its patrons in no small degree. The influence is extended through the neighborhood, the town, and to adjoining towns. The town in which the creamery is located will be referred to as a prosperous town, and, to illustrate, I will refer to my own experience. I have tried to carry on my farming operations by improved systems and have received letters from Virginia, Georgia, Illinois, Wisconsin, and Iowa, asking questions in regard to my methods. I think the preface to the book to be issued by the honorable gentlemen, who are to follow with the sound sense, is enough to give you an idea of what they are to say. I will bid you good night and give the floor to those more worthy to instruct you.

The subject was discussed by John G. Tallant, of East Concord, and others.

Dr. I. A. Watson, secretary of the State Board of Health, read the following paper on "Milk from a Sanitary Standpoint":

MILK FROM A SANITARY STANDPOINT.

The question of providing the people with a pure milk supply is one that is to-day receiving much attention from sanitarians and other scientific investigators. The subject has extended far beyond the consideration of fraudulently placing a watered or otherwise inferior milk upon the market by a few unscrupulous venders, and has become a scientific question with which the interests of the producer are inseparably connected.

The dairyman who would excel in quantity and quality of milk produced must apply, at least, all that science reveals regarding the subject, even if he does not understand or study the facts that lead to the revelation. It is not to be expected that all dairymen will become scientists, but they can, if they will, ac-

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cept the results of investigations and apply them with great advantage.

The researches made within a few years into the cause and nature of certain diseases, demonstrating, as it has, very much that before was unknown in the processes of organic life, have in no other department of food production contributed so much of importance as upon the subject of milk supply. The absolute demonstration of the germ theory of disease, and the comprehensive knowledge of various other micro-organisms that take part in or induce many of the phenomena that take place in the organic changes and operations incident to animal and vegetable life, have shown us that no other product is so susceptible to infection and contamination as milk.

The word "contamination" is used in this connection as implying any alteration induced by organic changes or from extraneous causes. Milk, as every producer knows, possesses remarkable absorbent qualities, while, owing to its nutritive properties, it is especially adapted to the development of almost every kind of micro-organism that may accidentally be brought in contact with it. Indeed, it may be said to be a natural media for certain organisms low in the scale of life, and so readily is it acted upon that its original character is always lost in a few hours, unless protected by a low temperature or some other artificial means.

The influences that affect the quality of milk may be stated in a general way as follows:

1. Breed and age.
2. Season and its attendant changes.
3. Feed and water supply.
4. Ventilation and general care of stable.
5. Drainage and other sanitary supervision.

Without a proper consideration of these items a perfectly healthful milk is not assured. It is true that chemistry will show whether milk from a given dairy contains the thirteen parts per hundred of solids as required by law, but it is wholly inadequate to determine if it contains an infectious or noxious principle that may have been introduced in a variety of ways without affecting the legal standard.

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The law simply guarantees to the public that the milk which they purchase shall contain a certain amount of solids. It does not specify any other quality than that demonstrated by chemical examination.

Every producer of milk knows that there are certain articles of feed and other conditions which may affect the taste, purity, and keeping qualities of the milk which an analysis will not show. An inspection made in 1884, in Massachusetts, showed that a herd of cows kept in the following conditions produced milk of the legal standard:

1. Herd of cattle largely selected from condemned animals at extremely low prices.
2. Overcrowding.
3. Filthy stables and filthy surroundings.
4. An extremely impoverished diet, malt (brewers' grains and sprouts), tomato skins, small quantities of salt hay, and bale hay and meal.
5. Filthy water pumped from a well driven through a pool of liquid manure under the stable.

Notwithstanding, the milk produced by this herd fulfilled all the requirements of the law. No one who has any knowledge of the production of milk will for a moment believe that the milk obtained from this herd was of such quality as would be produced by a herd of well-kept cattle. Milk produced under such conditions would be utterly unfit for small children dependent upon it for sustenance, even if it were innoxious to persons in adult life.

The question of breed, age, season, and food, in their relation to the production of milk, has been too often and too extensively considered to be here discussed, so far as quantity and quality with reference to the legal standard are concerned. In regard to feed, however, water supply, ventilation, drainage, and sanitary supervision, there is much which undoubtedly has not been fully, if at all, considered by the dairyman.

Prof. Girard, director of the Paris Municipal Laboratory, in a paper upon the "Feed of Milch Cows," published in the "Revue d'Hygiène," says in a summary of his conclusions:

"1. The udder cannot be considered as a filter so perfect

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in its nature that water charged with poisonous ingredients becomes harmless and healthful in its passage through it.

"2. Every substance which contains a noxious element, germ, microbe, or poison, capable of mingling with the blood, should be absolutely removed from the feed; since the milk is derived directly from the blood, everything which passes into the latter may also reappear in the milk."

Good ventilation is as essential to the welfare of animals as of man. So important is this matter regarded in some localities that the amount of air-space per cow has been fixed by regulation. The Metropolitan Board of Works, of London, in regulations for cow-sheds, fixed the air-space at 800 cubic feet per cow. The Dairymen's Association petitioned to have the amount reduced to 600 cubic feet, chiefly on account of the low temperature which followed the carrying out of the regulations, by reason of increased space per cow.

Dr. Parkes, of England, who is recognized as one of the ablest sanitary authorities in the world, states that each cow in every milk-stable should have at least 1,000 cubic feet of air-space. He further says that in cow-houses disease and death are in direct proportion to foul and pure air.

In the city of Brooklyn, N. Y., regulations require 1,000 cubic feet of air-space to each cow. This subject and that of general cleanliness in and about the stables are under municipal regulation and inspection in many places.

The health commissioner of Milwaukee in 1880 caused a thorough inspection of the stables in his jurisdiction to be made, and the result showed that in a very large majority of cases no attention whatever was paid to sanitary requirements. In many stables the condition was absolutely filthy; a large number were wholly unventilated; in others there was great overcrowding, and in some very little light. In many stables the atmosphere was loaded with putrescent vapors; liquids ran through the floor, saturating the earth beneath, which of course produced a putrefactive fermentation which constantly generated poisonous gases. In other places the general uncleanliness of utensils used in carrying on the milk business was noticeable. While conditions varying from those classed as "unexceptionably good" to "abso-

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lutely repulsive" were described in the report, the latter largely predominated in numbers. Out of 1,871 only 713 were classed as "unexceptionably good," while the remaining 1,158 were classified in varying degrees down to "absolutely repulsive."

These facts are given for the purpose of showing the sanitary neglect which exists even with the knowledge that is accessible upon the subject. It is quite possible that the conditions just described do not apply to the dairy stables of New Hampshire; but it is true that they do exist in too many instances among the smaller producers of milk.

Dr. Abbott, secretary of the State Board of Health of Massachusetts, who has given much attention to the subject, says that a radical change is needed in a great number of cow-stables throughout the State, not only as to feed, but in the matter of ventilation, of lighting, of overcrowding and air-space, cleanliness, water supply, and drainage.

So well is the fact known that certain articles of feed affect the milk that most producers are now careful in its selection; but many of them, and perhaps a majority, entirely ignore the subject of water supply. Dairymen who are careful to exclude decaying vegetable and other kinds of tainted feed allow their cows to drink water that is loaded with organic impurities. In some instances the water supply is from a well situated in a convenient locality, frequently in the barnyard or under the barn, where it must, from the very nature of its surroundings, be badly polluted. It is not improbable that from this cause alone an inferior milk and butter are often produced. To what degree the impurities taken into the circulation from polluted water are eliminated through the milk, is a question worthy of consideration.

Investigation shows that polluted water is a most prolific source of disease in the human family, especially of typhoid fever, and it is reasonable to suppose that water unsuitable for domestic purposes is also unfit for consumption by animals. The recent examination of a large number of wells in different sections of the State confirms the belief that a well of pure water is the exception, and that a majority of the wells are polluted with some form of organic matter. Every one knows that a well is a

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hole in the ground, constructed in a certain manner, and deep enough to reach water; but they have not considered the fact that it drains a certain area of soil represented by an inverted cone, the apex of which is the bottom of the well and the base the surface of the ground above. The distance across the base is usually regarded as twice the depth of the well, although under certain conditions of the soil it may be much greater. So greatly does this rule vary that it is an unsafe one to follow. It is evident, therefore, that waste products deposited upon the soil drained by the well will, in the course of time, leach through the earth and contaminate the water. The process goes on so slowly that the organic matter that reaches the well often loses both taste and smell and is not recognized. In several instances in this State eighty grains of organic matter to the gallon have been found, while the normal amount should not exceed four grains; and yet the contamination could not be recognized by sight, taste, or smell. The wells at hundreds of our country homes are located in the most favorable positions to become polluted. Around them in close proximity are sink-drains, family vaults, hog-pens, stables, barnyards, and refuse matters of various kinds. The products of the dangerous environments gradually filter through the soil and load the water with tasteless, and odorless, and sightless poisons.

In answer to some questions submitted to the physicians of New Hampshire last year relative to typhoid fever, out of one hundred and twenty-nine who had treated the disease fifty-three, or forty per cent, reported water pollution to be the cause. Water is a great solvent of organic, and, to a certain extent, inorganic matters. The falling rain takes up impurities into the air and imbibes to a great degree the soluble products that it comes in contact with upon the surface and in the soil.

Upon the soil in the immediate vicinity of dwellings not connected with a sewer a large amount of waste matter is necessarily deposited, aggregating many tons annually at a single dwelling. A great part of this product is fluid, chiefly sink-water, and what does not evaporate or run off is received into the soil. For a short time, on new and clean lands, such products are taken up and oxidized or otherwise changed; but by and by the soil be-

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comes supersaturated and loaded with impurities. Now a well situated in the immediate vicinity of such conditions, as hundreds in this and other States are, must from the very nature of things become contaminated. The degree may be little or much according to circumstances.

The falling rain and water from melting snow leach through the filth-saturated soil and reach the well. The top of the well may be covered with a painted plank platform into which is set a pump of the most approved pattern; the ground immediately surrounding it may be of clean gravel or beautifully grassed, so that the external appearance is pleasing to the eye and suggestive of unscrupulous cleanliness; but beneath this fair exterior little channels and water-courses may be carrying to the well, slowly but surely, the bitter seeds of sickness and death. Wells of this character become cesspools, out of which we continue to drink daily because we do not smell, taste, or see the infectious principle that is held in solution in the water.

It is not only self-evident to any one who has carefully considered the subject of polluted water, but is also proven by experience, that water from such sources should not be used for supplying the dairy stable, or in washing or cleansing utensils in which milk is kept. The custom which is in vogue among some producers, of washing butter in water, should be looked upon with suspicion whenever the water supply is from a well that may possibly be polluted. Milk has oftentimes been the medium through which diseases have been transmitted, especially typhoid fever, diphtheria, and scarlet fever. In cases of typhoid fever transmitted by milk, the intervention of infected water has always been proven. In diphtheria and scarlet fever the germs of the diseases seem to have been absorbed by the milk directly from an infected atmosphere. The epidemic of typhoid fever at St. Pancras, England, a few years ago, was proven to have been caused by infected milk. The investigation was most thorough and the facts obtained conclusive. The vault into which were thrown the dejections of a typhoid fever patient was not over twenty feet from the well. The milk cans, pails, and all the dairy utensils were washed in water from this well. There were 431 cases in 276 houses; all but 63 of the 431 cases received the

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infected milk, and it was probable that all received the disease from the same source.

At Port Jarvis, N. Y., an outbreak of typhoid fever was traced to a dairy farm where all the utensils of the dairy were washed with water contaminated by a cesspool. In nearly every family using the milk there were one or more cases of the fever. The physicians believed that the germ of the disease was contained in the water used to wash the cans, pails, etc. A few years ago at Aberdeen, Scotland, typhoid fever broke out simultaneously in nine families. Investigation showed that these nine families obtained their milk from one small dealer at whose place the disease existed.

In 1876 an epidemic of typhoid fever occurred at Eagley, England, which was traced directly to the milk supply. Fifty-seven families were supplied by one dealer, and out of this number fifty-five contracted typhoid fever. It was shown that the milk cans were washed in water poisoned by the dejections of a typhoid fever patient. However, it was denied that the milk was watered. In a report of the epidemic the health officer states that "not one household to which the milk was traced did I find entirely free from the disease."

In 1880 an epidemic of thirty-two cases of typhoid fever occurred from infected milk in Southport, England. The milk cans were washed daily with water from a well that was infected with typhoid fever germs. The cause of the epidemic was discovered and its extension curtailed by stopping the sale of the milk.

In a recent number of the "Sanitary Engineer," the remark is made that there is little doubt that we have in this country, and especially in our large cities, typhoid fever from milk contamination; but it has not been well estabished. The reason for this is that our investigations are not so thorough as the English, and when we fail to find the disease in infected water our researches cease.

It is believed that diphtheria and scarlet fever have been repeatedly conveyed to individuals through infected milk, and that the germ of the disease was absorbed by the milk directly from the atmosphere. Several instances are on record. An epidemic

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of scarlet fever in London, a few years ago, was traced directly to the milk supply. The disease was confined to the exact district of one milkman, and so marked were the lines that the inhabitants upon one side of the street, who were supplied from another source, did not have the disease, while upon the opposite side every house was infected.

More care is needed in the storage of milk than is generally thought necessary, and this, especially, where there is illness of any kind in the family of the dairyman. In such instances the emanations to which the milk is exposed are of a diseased and dangerous character, and subjected to such influences it is impossible for the milk to retain its normal purity. There is an abundance of evidence on record to show that disease germs have been in this way absorbed by the milk and transmitted to persons.

Dr. McDougal, in an address before the Philosophic Society of Glasgow, on the subject of milk as a vehicle of infection, said that it is "a congenial soil for the preservation, and probably even the multiplication, of specific infection."

Dr. Sternberg, the distinguished American biologist, says that milk would be a suitable culture fluid for the experimental reproduction of disease germs in the laboratory, if it were not so readily infected by other germs which float in the atmosphere, thus showing how readily it is contaminated by various organisms.

Dr. Vatcher, a celebrated English authority, in writing upon the transmission of disease by milk, states that it may be transmitted as follows:

1. It may be derived from a cow suffering from a specific epizoötic disease.
2. It may be derived from a tuberculous cow.
3. It may be drawn from an inflamed udder.
4. It may have undergone chemical or fermentative changes.
5. It may have become infected with the contagium of a human disease.

Under the classification of epizoötic diseases likely to occur in cattle, he mentions pleuro-pneumonia, splenic fever, and foot and mouth disease. It is quite likely that the danger of milk

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becoming infected by reason of the acute diseases just mentioned is not so great as might be expected, from the fact that the milk secretion is usually rapidly arrested after an attack.

Whether or not pleuro-pneumonia germs are secreted by the milk is not certain, so far as my information goes; but since the germs of this disease exist in the blood in great numbers, it is not unreasonable to suppose that some of them might be secreted in the milk.

Splenic fever is communicable to man and is nearly always fatal if the infection is internal; external infection by a scratch or similar introduction of the virus produces malignant pustule which is often fatal. The milk and butter of animals affected with this disease possess virulent properties, according to Heusinger and other observers.*

The foot and mouth disease always exercises a marked influence upon the character of milk. It contains not only the germ organisms of the disease but frequently we have pus and even blood. From such milk the disease has often been communicated to the human subject. Its communicability was discovered by Sagar as long ago as 1764, in Moravia, who observed the disease in human beings who had drank the milk of cows suffering from the foot and mouth disease. Similar observations were made by Brosche in 1820, in the instance of some young girls who had contracted the disease from milk. Still later, in 1827, in Bohemia, where the disease was prevailing extensively among the cattle, young people were attacked with an inflammatory lung fever accompanied by an aphthous eruption in the mouth or an exanthema resembling that of small-pox, and also by abscesses and ulcers upon the lower extremities. Schneider reported entire families who were made ill by the use of butter and cheese made from the milk of cows affected with this disease. †

A few years ago the disease appeared in a dairy at Brighton, Mass. The milk of the infected cow, together with that of thirteen others, was sold to the consumers during a period of two or three days, when the disease was discovered by the proprietor, who immediately and very justly notified his patrons of the trouble. In one of the families supplied the disease broke out in the

* Ziemssen, Vol. III. p. 408. † l. c. p. 521.

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course of a few days in three individuals, all adults. The symptoms consisted of "loss of appetite, nausea, slight acceleration of pulse, swelling of tonsils and sub-maxillary glands, the appearance of a few vesicles upon the lips and tongue, and a singular cutaneous eruption on the lower extremities, consisting of clusters of papules, vesicles, pustules, and ulcers of different sizes."* Another case was found in a woman in another locality and traceable to the same cause. There is upon record a great abundance of evidence showing the facility with which this disease is communicated through the media of infected milk, butter, and cheese.

Tuberculosis, or consumption, is a disease not uncommon among cows. The experiments of Klebs, Gerlach, Orth, and several other equally able investigators† in feeding tuberculous milk to animals certainly go to prove that it may be communicated to them, and it is believed that it has often been communicated to young children in the same manner. Prof. D. E. Salmon, D. V. S., of the Bureau of Animal Industries in this country, believes that tuberculous milk is an exceedingly prolific source of consumption in the human family. From the direct experiments of tuberculous milk made upon the lower animals, we have the strongest evidence that infection of the human subject, especially children, might readily follow the use of such milk. The identity of tuberculosis in animals to consumption in man has been fully established. The germ, or bacillus, is morphologically the same and there is no distinction in the pathological lesions. It is also positively asserted that there are clinical observations proving the transmission of tuberculosis from animals to man through the use of tuberculous milk. In the report of the Bureau of Animal Industries for 1884 it is stated that certain herds were supplying New York city with milk containing twenty, thirty, and even fifty per cent of animals affected with the disease. In some districts of New York can be shown large herds with 90 per cent the subjects of tuberculosis, and in this connection it is asserted that 29 per cent of the adult males dying in New York city are tuberculous. The same report says:

* Report Massachusetts State Board of Health, 1871.
† Public Health, Vol. VIII. p. 169.

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"Turning to milk, it cannot be denied that boiling would give the required guarantee of safety; but in the *milk-cure* establishments and where this liquid is produced for infants, it is sought fresh and used without boiling, and yet these places seek for the heaviest milkers, and often secure tuberculous cows. For these, and indeed for all dairies, there should be a state control of the milch animals and their products. In the present state of public opinion it may be possible to apply measures that will be really effective in preventing the sale and use of tuberculous meat and milk, yet, where already applied, the preventive measures have proved so beneficial that we must advocate their maintenance and extension."

In this connection it should be impressed upon the minds of the people that tuberculosis is the most fatal malady known to mankind. The number of deaths occurring in New Hampshire annually from this disease, directly and indirectly, exceeds one thousand; between eight hundred and nine hundred are directly charged to it, being twice as many as from any other disease.

In incurable disease, like cancer for instance, it is not unreasonable to suppose that the milk must be diseased. Cancer is very frequently found in milch cows, and cases are on record where milk has been sold from animals suffering with the disease in an advanced stage. A case was discovered in one of the towns in this State in which the cow was suffering from two large cancers, one on each side of the face. The animal had been kept for four years in a dark and filthy cellar out of sight, the milk meanwhile being sold daily to customers who supposed they were getting an excellent quality. Whether cancer cells are eliminated in the milk is not known, to my knowledge, but it is certain that normal milk cannot be produced from a diseased cow, and a man who would sell milk under these circumstances deserves to be compelled to use the product as his sole diet.

Milk from a "gargety" cow should be rigidly excluded from domestic use, as it contains bloody serum, pus, and other fetid animal products which at once condemn it. The condition termed "gargety" is simply an inflammation of the udder and is not a specific disease, yet every milkman should be careful to exclude such milk, for it has been known to produce indigestion and even toxic effects in the individual using it.

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Very much might be added to that already cited to show how readily milk becomes infected under a great variety of circumstances and causes, but this would seem to be sufficient to illustrate the points in view. A knowledge of the various evils suggests, in a great measure, the methods necessary to avoid them.

It is necessary that no detail should be overlooked in the care of milk from a sanitary standpoint. The milk should be drawn in as cleanly a way as possible, and even then, except in perfectly sound animals, there is danger that the milk may contain some germs of disease. From the healthy cow there is received into the milk-pail, under the best conditions, some foreign matters like hair, epithelium cells, and other animal debris.

It is perhaps unnecessary to remark that milk should be immediately strained through a very fine sieve or cloth strainer and removed from the stable to a place not exposed to odors or an impure atmosphere. The great avidity with which milk absorbs any taint renders this a matter of the greatest importance, as well as that all vessels into which it is put should be *absolutely* clean. In some parts of Switzerland, it is said, milk is strained with excellent results through sprigs of well-washed fir-tops placed in a funnel, and the milk filters through as fast as milked from the cow, thus arresting at once hair, skin, clots, epithelium, and other matters.

It is not to be presumed for a moment that the unsanitary conditions mentioned apply to a majority of the dairy farms in this or any other State; but it is true that a total neglect of good sanitary conditions exists to such an extent as to give force to all that has been said, and the odium which a single bad dairy stable casts upon the entire industry is not to be overcome by the fact that most dairies are suitably cared for.

The remedy for these defects must be applied largely through siutable laws and their impartial enforcement, in instances where a knowledge of the subject is not sufficient to insure proper care in the production and sale of milk. Pure milk can be assured in two ways: First, through the conscientious endeavors of the dairyman, through proper feed, care, and sanitary management; second, by compulsory laws which shall secure these conditions

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through the executive work of a qualified inspector whose duty it shall be to examine the dairy stables and all conditions connected therewith pertaining to the subject of milk production.

SECOND DAY.

Mr. O. M. Tinkham, president of the Vermont Dairymen's Association, was the first speaker.

Among the good things said, we select the following: While there may be those farmers who desire a general-purpose cow, no dairyman would select anything but a *special* cow — a butter machine. He recommended intelligent and liberal feeding. He would recommend thoroughbred Jerseys, partly on account of the profit derived contingently from stock sales. Would avoid sour meal and excessive feeding of ensilage. Dairymen could transgress all rules with impunity, however, provided excessive cleanliness was observed. With a good Jersey cow, the cream line would be apparent on the milk in an hour after setting, while it was much longer rising on the milk of other breeds having small butter globules. Good butter can be made by any method of setting. Farmers must settle the question as to creamery or private dairying by figuring on cost of help, and ability to manufacture their products so as to net more than returns from the creamery.

The remainder of the forenoon was spent in discussing the methods of dairymen present, regarding working and salting butter. The majority washed in either water, brine, or both. "Brand your goods and make to suit your customers," was Mr. Tinkham's remark, which he aptly illustrated.

Afternoon Session.

Mr. George S. Philbrick, of Tilton, gave the leading paper on "Feeding."

Mr. Rollins, of Bedford, read a paper on "Soiling," giving the rotation followed on his farm, which gave green crops for his cows until time to open his silo. In May, rye, followed in order by clover, rowen, oats, early-sown corn, second-crop clover. He sows barley, following early potatoes, which runs until

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heavy frosts. He puts the saving in drying, manure, and the comfort of the animals against the care and labor attending the raising and daily harvest of soiling crops, and points that out as the high road to extra production and increased fertility. Secretary Adams said he had followed similar practices, only on a less productive soil. He also raised Hungarian grass and cow peas.

Samples of butter from Short Falls and Island View creameries received commendations from the committee. A few good samples were also shown from private dairies.

Following the report of the committee many good things were said during the general discussion, for which we have not space, and only regret that they do not go on record, and that the large number of dairymen who remained away will go on making butter without the benefit of the knowledge which they might have carried home had they been present.

Evening Session.

Hon. Edward Burnett, of Southborough, Mass., gave a talk on "Our Dairy Interests," and the following report of his address was taken from the "Massachusetts Ploughman":

OUR DAIRY INTERESTS.

Gentlemen and Fellow-Farmers:

I am not here to deliver an address, but simply to talk upon dairy matters as a subject which you know is my specialty. In beginning a talk upon the dairy, I always say that there are three important things which, if fully observed, will surely lead to success. These are, in the first place, the feed; in the next place, the stock; and in the third place, care and skill. Those four words, I think, embrace the whole thing, and all that is necessary to success. In the first place I put feed, because it is really the most important of the three, although without one of the others — care and skill — no man can be successful. In making butter,— and I shall touch more particularly upon making butter, and shall speak from experience and very close observation, — there is no question in my own mind but that feed is more

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important than the cattle. You may have the best butter cow in the world, and unless you support her on the right sort of butter feed she will not make good butter. I have studied the matter carefully myself, and I know that unless you have good butter feed for your butter cows you cannot succeed. If I could have only one of the two, butter cows or butter feed, I would take the feed. I would rather take the poorest cows on butter feed — that is, the right sort of feed for butter — than take the best butter cows with poor food.

I think that probably the best illustration of the men that are most successful to-day in making butter, if we gauge that success by the money they get for their butter, are the Darlingtons of Westchester, Pennsylvania. These men have for years, and their fathers before them, made the greatest study of feed and what it will do. If you visit their farms you will find evidence of this in the fact that they are making an article of butter that brings right straight along at retail a dollar a pound, and at wholesale,— they make 600 pounds a week generally,— in the winter, that butter brings eighty to ninety cents a pound. Those men use nothing but common cows. Of course they have taken great pains to get dairy cows and to buy only good butter cows. Their dairy is simply a large machine, and when a cow is put into it, it is expected that she will be managed for producing butter, and that one product alone is her specialty. I have looked into this matter very carefully, and as to the feed I was surprised to find that they were feeding clover hay, only, with the best Indian meal. They gave ten quarts a day of the best Indian meal to a cow. When they have kept their cows on it for eight, ten, or twelve months, they are in good order. We can understand that. They sell off their timothy hay, most of it, to go to Philadelphia for horse hay, and they buy wherever they can find it the best clover hay, and feed it to their cows. These men are the most successful dairymen in this country for strictly fancy butter. Now, some one may say that I am disposed to favor Jersey cattle, but these men use Guernseys, Jerseys, Holsteins, or any thoroughbreds, but they rely upon the feed to produce these results.

Now, I may say this, for perhaps some of you gentlemen have visited those farmers, I will say that the feed is the main

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thing in their treatment. This is not a theoretical thing, but is a statement of facts. That is the rule at the Darlingtons', and I think it is acknowledged that there are no better butter-makers in this country to-day.

I have always connected this fact with their feeding of clover. I know myself from my own experience how difficult it is in some years when it is dry, especially during the last few years when we have had drought, to raise good clover. You can raise clover on good, rich land, if it is adapted to its growth, and if it is in good heart. A great many people, for I have talked on this question with many, will say: "Burnett, how can you cure clover? I believe in clover, but I don't know how to cure it, and when my clover grows pretty rank and is packed into my barn I have nothing left but woody and fibrous stalks. The leaves have all been shaken off." I find that the trouble is, in the first place, they cut it and try to dry it just as they would ordinary hay. Now, the most successful men in Westchester, in that famous country for butter, do not cure their clover in that way. I saw them harvesting it when I was there. They cure it by cutting it early, cutting it when it is in full bloom, or just as it is coming into blossom. They cock it into small tumbles, and all they do to it — cutting it in the evening or the afternoon, — is to roll it it into these small tumbles in the next forenoon, or in the middle of the day. That clover lies there until it is ready to be put into the barn, being turned over two or three times a day. It only takes two or three days to cure clover that way. If a shower comes up, they put two or three or four of these tumbles together, and the rain does not wet it much. Every one of you know from experience that if hay has stood in the tumble over night it will shed water very much better than if the shower comes up within the first hour. I know that clover is coarser than other hay and will catch the rain better than fine hay, but at the same time you would be astonished to see how little rain will penetrate into three or four of these tumbles that are put up in nice form as they should be.

Well, I shall not touch longer upon butter, for I am here to talk more upon cattle, but I cannot say anything to the farmers upon making butter, or supplying milk to the creameries that

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make butter, without speaking of clover hay. I had a long talk this fall at Des Moines, Iowa, at the time of the state convention, with Hon. H. D. Sherman, the dairy commissioner of Iowa, father of all this family of creameries. Sampson, McIntire & Co., in Boston, are probably the largest agents of these Iowa creameries, and own some of them. Mr. Sherman is a man that has brought the product of Iowa up to about the highest price in the market to-day in New York, Boston, Chicago, whereas ten or fifteen years ago it used to bring the lowest price. The dairy butter from Iowa used to bring in Chicago, fifteen or twenty years ago, and in other places in the West, the lowest price; it was put up in seventy-five and one hundred pound barrels and brought about as little money as any butter that was sold in Chicago, and now it is sold in competition with the best butter of any part of the country, and competes with the Elgin. This has been done since H. D. Sherman was appointed dairy commissioner for Iowa.

He agrees with me on the food question. He said that the commissioners found that the people were making a serious mistake, and it was hard to make the farmers realize the need of having better cows, for in order to do that they must have better feed, and he has brought about the change by proving that on clover feed the cows will average better than on any other kind of fodder that could be fed to them. I also appreciate very well the fact that we cannot feed clover all the time. I have never fed clover alone all the time for my stock. You must get some other food to feed them with a part of the time and then you can carry them right along. You want hay or good clean corn fodder. I have used corn fodder daily for my cows and have been much pleased with the result. I also use in feeding my cows the old-fashioned cob-meal, and if you make a good use of clover hay with that cob-meal you will get excellent results. But you want to have the cob-meal ground at least once a week. You do not want to lay in enough to last all winter or a month. If you do, the meal loses its flavor. You can realize the fact, or at least your wives can, who make meal into Johnny-cake. They know that the best Johnny-cake is made from meal freshly ground. That is so of meal used for butter.

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All these little things go together and if you observe them all you can get a good price. If any one of these little things are left out, it will not make so good butter. But if they are all observed you will make better butter and get a better price.

I am always a strong advocate in winter of the use of roots. I have not had any experience with ensilage, but I find that men who have used ensilage in moderate quantities do not have any better results than I, and I get good results with roots and can make good butter with them. If I could make to-day a dairy after my own heart and feed my cows just as I wanted to, I don't think I should feed any ensilage. I do not want to say much on the question of feed, but this is an informal talk. I am here to-day as a fellow farmer and I should be delighted if any of you were disposed to ask me any questions. I love this subject and I wish that I could answer any questions that may be asked.

I will leave the subject of feed and come to that of stock. I suppose that you will all say that I am a breeder of Jerseys, and, therefore, that I think there is no cow like the Jersey. But that is where you are mistaken. I recognize this, that there are other thoroughbred animals than the butter cow. But there have been some very curious statements made by the breeders of rival breeds and by Jersey breeders. I believe in the Jersey cow, but I don't believe that it is the only breed in the world. I was very much amused, and rather astonished, at my friend, Gerrit S. Miller, who delivered a paper before the State Board of Agriculture, in Barre, a few weeks ago, in which he made very strong statements. The paper was on Holstein cattle, and he claimed for them everything. He made one statement which I want to correct in public. As I said after I heard this paper, "I know Get. Miller, and have known him for a long time, and want to take occasion to call his attention to this matter when I get a chance." He made mention that, though the Jerseys were raised numerously on the island, they did not send any butter to the London market. He asked: "How much Jersey butter is put into the London market, and how much comes from Holland?" I suppose that nine tenths, yes, ninty-nine out of a hundred, of the farmers that read that statement would naturally say that

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they never knew of Jersey butter being sold in London. But Dutch butter and Danish butter is sold by hundreds of thousands of pounds in London every year. Let us see how large is the Island of Jersey. It is five miles wide and twelve miles long, and it contains only thirty square miles. Yet on that island there are about 4,000 cows. On those thirty square miles live 60,000 people. That is, 2,000 people to the square mile. There is no farming country in the world that carries that number of people to the square mile. Just think of it, 2,000 people to one square mile. What do those people do? They are the best farmers, and yet the crudest farmers, in the world, yet their cows cannot support them, but they import $1,500,000 worth of produce every year. Their great crop is potatoes, to be sure. Those 4,000 cows every summer have to support an influx of from 500 to 1,500 visitors. Those English people from London, Southampton, and Bristol, and from other cities, who come over there, want to live upon milk. They don't make butter enough for the Island of Jersey, and cannot meet their own market. How can they supply London? They cannot do it from that little territory. They do make, I think, at least one half of the supply for the population of the island.

Now see what amount of land we find in Holland. There are 15,000 square miles instead of thirty, and a population of 3,500,000. Look at it, gentlemen. What have we got? About 230 people to the square mile. On the Island of Jersey there were 2,000 people to the square mile. If any one of you has ever been in Holland, he knows what Holland is. It will raise more to the acre than any other land in the world. So it was rather an unjust statement to make about Jersey and the London market. I was very much amused, being a friend of Mr. Miller, and knowing that before he became a breeder of Holstein cattle he quite agreed with me that there was a great difference between cows which are raised for butter only, and those which are raised for other purposes.

When you talk about butter cows, you want simply a cow that will make the most butter from the smallest amount of milk. If any of you have raised a Jersey, or a Holstein, or a Guernsey, you know the average weight of these cows. Now, I want to get

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the best average results, and I do not want a comparison of single instances, but with average Holstein milk. I have weighed a great deal, and it takes from 25 to 30 pounds of milk to make a pound of butter. That is the average result from the Holstein. But with the best grade of Jerseys you can get a pound of butter from 15 to 20 pounds of milk. There is a difference, you see, of over 33 per cent in favor of the Jersey.

I think myself that the Jerseys have been bred altogether wrong in the last twenty years. Most of the cattle have been bred simply from solid-colored bulls. Gentlemen, that was a great mistake, and we should turn our breeders' attention to breeding from good butter bulls. These should be from cows that would make from 10 to 14 pounds of butter a week. I would rather have a grade Jersey that would make 20 pounds a week than 30 pounds a week. I believe in good average results, but not in phenomenal results. All of you may want a chance to see what a cow will do, but the farmer wants average merit rather than one or two famous individuals. The breeding of Jersey cattle has been in the hands of a few farmers, but a large number of gentlemen, who are men of wealth and want to enjoy looking at their cattle, visiting their stables, and admiring their beauty, have been the cause of this individual development. I do think that a Jersey cow in her prime is one of the most beautiful animals to look at there is.

I admire, to a certain extent, solid color. But I would rather have a mottled bull from a fourteen-pound-a-week cow than a $500 bull of solid color from a cow that did not give five pounds of butter a week. We have got to breed that class of Jerseys, and we have got to put a constitution into our cows. We have got to put a good belly on our cows. We have got to give them the capacity to take better feed and digest it, and convert it into butter, and rear their young. Some of our Jerseys, I will admit, and it has often been thrown in my face, are so thin that a puff of wind will blow them away. Take a Jersey cow that has been on my own farm. You will find that she has a good constitution, and her milk will make from 300 to 350 pounds of butter a year. Well, that is what tells the story. My friend, Mr. E. B. Douglas, of Shoreham, Vt., from ten Jersey cows — I think they

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are all registered animals — makes a profit, over and above all expenses, of $72 per cow a year. That tells the story. What did that man do with his butter? He sold it in the New York market. He went to several of the hotels himself and took samples of his butter. He sold it for only four or five cents above the market price. He did not get any fancy price, and yet at that rate he made a profit on his ten Jerseys of $72 each a year. Obed Whipple, of North Pomfret, and Mr. Wood, of the same town, will tell you of their herds of Jerseys which averaged over 300 pounds a year each. They get a good price for their butter, but not a fancy price. They make from $50 to $60 a year on each of their cows in their dairies. That is what tells the story.

We must take the different breeds on their merits, and you will not find, on the whole, a milking breed of more merit than the Jerseys. Some Jerseys have been carefully bred for butter in this country. You will find at my farm that a great deal of credit is due to my father, who began the breeding of Jerseys thirty years ago. There are cows that will weigh 1,200 pounds. I have caused every cow in my stables to stand on the scales. I don't think I have a pure Jersey cow on my farm that will not weigh 950 pounds. I have almost forty of them, and the highest will weigh 1,215 pounds, while the lowest is in the neighborhood of 950, and that is a good-sized dairy cow.

Now, gentlemen, while we are on the breed of cows, I want to say one word about the strong claims that rival breeds make for butter. I will simply call your attention to the fact that at the beginning of the present century, the Short-horn cow in England was called the best dairy cow there. And what is she to-day? The best English Short-horn breeders have devoted their lifetime to perfecting this breed and to bringing them up to the point where they will make the most fat with the least waste and for the smallest amount of money, and we have to-day an animal that is the most perfect machine in the world, which will produce beef with the smallest amount of waste. That is the typical thoroughbred Short-horn. But what do we find that in the last century they have done? They have simply turned the order of nature upside down. Among these experienced farmers

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to-day we find cows that will not give milk enough to rear their own young. Some breeders are obliged to buy wet nurses in order to get milk enough to bring up their calves. Some of them don't pretend to keep their calves on the cows more than a few weeks, just long enough to check any inflammation of the udder.

Look at the different characteristics of the beef and dairy breeds. Why, the difference is just as much as the difference between a draft horse and a thoroughbred running horse. I think that Dr. Loring's definition of a dairy cow, which I heard him make at a meeting of the farmers in Essex county, at D. V. Appleton's in Ipswich, was one of the best I ever heard. He defined a dairy cow; I cannot do it as well as he did, but he spoke of a dairy cow as one that was not necessarily a thoroughbred cow, for it was no matter whether she was a Holstein, or a Jersey, or a Guernsey, or any other breed, for every farmer will acknowledge it to be a fact that the typical dairy cow, when you find one, has one of the most splendid organisms in the world, and at the same time one of the most delicate. You take a cow that is very clean built, and firm, with rather a refulgent and prominent eye, thin neck, clean over the withers, and splendid constitution, with a straight back and very broad across the hips, with an immense barrel or V shape, looked at from behind, and an udder that is well forward, and at the same time that is well up behind and well wrinkled, and you have got a machine that is about as delicate, and which will take as little to throw into disorder, as any machine in the world. You take such a cow as that, no matter what her breed, and put her into a New England meadow and she will come in with the milk almost pouring out of her teats. You have got there a cow that will give in the flush from eighteen to twenty quarts of milk a day on good feed. But how easily that cow is disturbed? If a savage dog comes out and barks at her as she is coming from pasture to the barn, even if he does not bite her, what will be the result? That cow will probably drop off one half in the next milking.

But how is it with a beef cow? Nothing will upset her. That cow will travel in the cars and care nothing about it. But a delicately organized milker would take a week to get over it. The beef cow takes the food into her stomach and it goes

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through the less delicate operation of being made into flesh. It does not require to be changed as much as when made into milk, and the beef cow thus does not need such a delicate organization as the dairy cow has. The beef cow digests her food and distributes it over the body and transforms it into meat just as you want it. Look at her disposition; it is happy and contented like any child's. As Dr. Loring says, she might be standing under a tree, and if it was struck by lightning, if she was not struck herself, in five minutes she would forget all about it and would not know whether there had been a shower or not. This is the difference between a beef breed and a dairy breed. When we buy a cow I think we ought to recognize the difference between these two types of cows, and remember that we want one to make beef and the other to make butter.

I have said but little about the Guernsey cow. The Guernseys and the Jerseys are really twin sisters. Originally they were admitted to have been the same, but the types are now different; and although those two little islands are but twenty miles apart, yet the breeds are very distinct. Their qualities are about the same; that is, I think a good Jersey cow and a good Guernsey cow will make about the same amount of butter. The Guernseys are larger than the Jerseys, but they are bred that way, and the average on the islands — the average, for instance, of the two animals on the Island of Macoupin — is not as great as it is on the Island of Jersey. On these islands most of these breeders pay too little attention to their bulls; but on the Island of Jersey they will pay five dollars for the service of a bull, and I think that they are going to accomplish wonderful results in the next few years, because during the last five years every bull from a fourteen or fifteen pound cow has had all the service he could take. The people are willing and eager to pay that amount for such service, and so they are likely to continue the service from these fifteen-pound cows.

On the Island of Guernsey they are behind the Jersey breeders. They are not up to the times, and the demand for their stock is not as great. Many of those old Guernsey farmers will drive a cow three or four miles to get service for a shilling, or twenty-five cents, and go right by the man who has the prize bull on the island and who only asks ten shillings, or $2.50, for the service.

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They don't realize the importance of bringing up the quality of their stock, and consequently they are not, in Guernsey, doing a great deal. I think, however, that in the next five years there will be a decided change and that the farmers will turn in the right direction.

I appreciate the Guernsey cow. I do not wish to be considered, as I told you to begin with, a Jersey breeder and only a Jersey breeder. The Holstein cow has got her place on account of the fact that she will make a large amount of milk, and you have the land and the feed to carry more Holsteins. I think there is no American breed like it, and I don't think there is any question about the value of the Holsteins for milk. They are a good farmers' breed, but they want the best feed and the best pasturage. I visited Holland three years ago, and I was never so much impressed with the abundance of feed in my life as I was in seeing what those cows were turned into. It would be like turning them into the best mowing-fields in the middle of June, when those big Dutch cows were turned out into the pastures in the morning. Those animals would get their belly full of feed within their own length and then lie down and chew the cud. During the whole day they would not wander away from the stable an eighth of a mile, they were in such an abundance of feed.

Take those cattle and put them on any New England dairy farm and what do you find? You will find that unless you supplement their pastures with a great deal of green fodder, — with an extra amount of green fodder, — those cows will deteriorate. They will easily lose many of their best characteristics. They have been bred for milk in such feed as this, and unless in some way you can keep up this abundance of fodder, you will not get so much butter from them. I do not think that dairy farmers, unless they are near some large cities, should make a large amount of milk, for these Dutch cows are not so well adapted to such circumstances as either the Jersey, or the Guernsey, or the Ayrshire. I regret very much, when I stop to think of it now, that the breeding of Ayrshires has not been kept up as much as that of those other breeds. As a boy I remember one of the most famous herds of Ayrshires that were ever brought to this country. They were selected by one of the best cattle experts we have ever known here. Those Ayrshires were famous for their milk, and

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the results which were obtained here in Massachusetts were such as to encourage breeders to raise Ayrshires. There is no better place for a herd of Ayrshires than our New England pastures. That is because they are better adapted to our climate and better adapted to our pastures and our soils. They came home, so to speak, when they came to this New England, but the Dutch cow does not come home when she comes here. She is in a foreign land. I think that in the next fourteen or fifteen years, my judgment, that it will be well to breed Ayrshires, will be confirmed.

I would like very much to say a word about young stock. I think we find that there is many a first-rate farmer who takes the very best care of his dairy cows but who neglects his young stock. Gentlemen, without care and without skill you cannot have good dairy animals. You cannot have them unless you take care of them. Now I have served a great many times as an expert employed to buy cattle for a great many different gentlemen in this part of the country. I always stop and consider how those cattle will be taken care of after I buy them. I have been given *carte blanche* as to price and told to buy regardless of cost. They have said: "It don't make any difference how much you pay for the cows, but I want a good herd of twenty-five animals." If the man, after I buy those cattle, does not look out for them personally and does not understand their wants, but leaves them in the hands of a hired man and that man doesn't take any interest in the cattle, what is the result? In a year's time, although I have used my best judgment and paid the highest price, that herd of cattle will be nothing but an ordinary herd and a rather scrubby-looking lot of cattle. It doesn't make any difference how valuable they were at first if they are not properly cared for, whether they are Holsteins, or Ayrshires, or Jerseys, or Guernseys, or any other. It does not make any difference what breed you buy, for, after you have made a good selection, if it is not supplemented with care, they will go down hill very rapidly indeed.

If, on the other hand, the man gives me a low margin, beyond which the cost of the cow shall not go, and I buy a herd for him, and he is fully satisfied and takes an interest in it and has a first-class herdsman, what is the result? I have had such cases, and in three or four years I have visited the farm and found that I

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should not know those cattle. Their improvement had been wonderful. They had been kept in the best shape and had grown to be perfectly satisfactory to their owner. Whereas, the most expensive herd that I bought, perhaps the same season, has gone all to pieces, and the man could not get twenty-five cents on a dollar for his cows.

That is so much for the care. I have been in positions where I have bought cattle for different uses, and I have seen many valuable animals in different herds. If I buy cattle I always try to keep up their acquaintance, and if I am in the part of the country where they are, I always visit them. I have always been impressed with the difference in the care of young stock. I believe that if an animal is not worth feeding well it is not worth taking care of at all, and, as I said to you to begin with, there are many farmers who take the very best care of their stock, but they don't seem to think that their young stock need anything more than just enough to support life, and very little of that, and even that little the poorest in the barn. If they can support life until the heifer comes into milk, they think that then it will be time enough to begin to take care of her and to feed her. I think this is a great mistake. I have seen two sisters from the same cow and from the same bull, and one was a runt and the other was a first-rate cow, and the difference was caused by the difference in their feed when they were calves. This treatment of young stock is not so common with thoroughbreds as it is with grades. The former cow was brought up as cheaply as it could be, and the latter was brought up as well as it could be, and the difference in the weight of those two animals was several hundred pounds.

These things come under the head of care and skill. Now I have given you my experience and my reasons for believing as I do, but I think many of you have heard them before, and I have occupied nearly an hour with this rather rambling talk. But if I have touched upon anything you want me to explain more fully in any way, I will do so with great pleasure.

Messrs. Tinkham and Burnett were tendered a vote of thanks and made honorary members of the association, after which the meeting was closed.

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MILK AND FEED.*

BY G. S. PHILBRICK.

We speak of the vast dairy interests of New Hampshire; we read it on the pages of every agricultural journal. Who grasps the meaning of the words? Who comprehends it?

I am going to run the risk of being dull and prosy to-night by giving you a few statistics.

There are in Rockingham county 12,808 cows; in Strafford county, 5,427; Belknap county, 4,970; Carroll county, 5,694; Merrimack county, 12,070; Hillsborough county, 16,002; Cheshire county, 8,355; Sullivan county, 6,396; Grafton county, 13,599; Coös county, 6,851, making a grand total in the State of 92,172 cows representing a cash value of fully $4,000,000. From the most careful estimates based upon experiments in different parts of the State, I assume it will cost $4,500,000 to feed the cows of New Hampshire one year. The interest on their cash value at five per cent will be $200,000; add to this $60,000 for taxes and at the end of the year we have $8,760,000 invested in our cows, a sum equal to one fourth the capital stock of all the railroads in the State. Add to this the amount invested in buildings, creameries, and dairy utensils of all kinds, and you will then only have a part of what goes to make up one side of the vastness of the dairy interests in New Hampshire. Having thus briefly shown you something of the cost, let us turn to the other side of the account and see what we get in return for this vast outlay of money. Does it pay? and, if not,

* Extracts from lectures on "Milk and Feed," delivered by G. S. Philbrick, member of the Board for Belknap county.

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what is the reason, and whence the remedy? Unfortunately there are no data extant sufficiently accurate to be of much practical value; but from the best information at command, I think we may safely assume that the cows of New Hampshire will not average over six quarts per day for the entire year, and for the past year that milk has not been worth over two and one half cents per quart at the place of production. Three hundred and sixty-five multiplied by six gives 2,190 quarts, which at two and one half cents per quart equals $54.75, as the gross income for each cow in the State for the year, or $5,046,417 for the entire herd of 92,172 cows. Deduct from this the cost of keeping, interest, and taxes, and we have $286,417 as the net proceeds. There are 32,000 farmers in the State of New Hampshire, averaging to keep three cows each. Dividing the $286,000 among them in proportion to their cows, they will have the magnificent sum of nearly $9 a piece. Doubtless nine tenths of them will have to invest that in commercial fertilizers to piece out the manure pile so they can raise enough to keep the cows another year. Startling as these figures may appear they can neither be gainsaid or denied.

That dairying as a whole in our State does not pay no thoughtful man will deny. That it ought to pay and can be made to is abundantly proved by the success of the few from Coös to Rockingham, who have studied the business and conducted it according to business methods. The first thing is an interest in the business and a determination to make a success of it. The next indispensable requisite is the cow. I know it is considered the correct thing to say that in the first place you must get a thoroughbred bull, and thoroughbred cows, etc., and to dilate upon the merits of the Jersey or the Guernsey, Holstein, Friesian or Short-horn, Swiss or Polled Angus, or some other breed which the speaker may chance to possess or fancy. But I do a great many incorrect things, and say a great many more, so you need not be surprised if I depart somewhat from the "beaten paths" in discussing this subject.

A herd of pure-bred cattle is "a thing of beauty" and may be a "joy forever," perhaps; I would say, get them by all means if you can. But the majority of us lack the necessary

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capital to start with, and sundry other essential qualities which I will indicate farther on. What I desire is, to point out a course which is feasible and within the reach of every farmer, whether he keeps 100 cows or only one. You must have noticed that some of your cows give more milk than others, when fed the same quantity; weigh or measure each mess for a week and carefully keep the record for each cow. That will give you a pretty accurate knowledge of the amount of milk every cow gives. To determine the richness of the milk, I would recommend the purchase of a "cream gauge;" or, you can take common glass tumblers and fill them two thirds full of milk as soon as it is strained, while the animal heat remains in it, I mean, and set them in cold water or in a cool place for twenty-four hours, being careful that each has the same treatment as the other, as it is comparative results you are after. The accuracy of an experiment alone determines its value. Measure the thickness of the cream as you can readily do from the outside, and also make a note of its color and consistency. This test will have to be repeated several times in order to approach exactness. You will find probably a difference in the richness of the night's and morning's milk and a difference in the richness of the same cow's milk on different days, even though the feed remain the same. There is something going on in the laboratory of a cow's stomach which no chemist has as yet been able to fathom. Sunshine and clouds, harsh words or cruel treatment, excitement from any and every cause, affect both quantity and quality of milk, as every one knows who has made the cow a study.

Now if you find a cow in your herd that falls below the average in quantity and quality both, you want to dispose of her to the butcher as soon as may be. If, on the other hand, she lacks only one, no matter which, try a system of feeding to correct the deficiency. Of course you all know there are certain feeds which tend to produce large quantities of milk, while certain others will add richness. As a rule you will succeed. That there are exceptions I am bound to admit, for I have a cow in my herd at the present time whose milk I have been unable to bring up to thirteen per cent solids on a system of feed which has brought the average of my herd up to considerably over fourteen per cent.

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What shall we feed and how feed it so as to produce the largest and best results from the least expenditure of money, are still open questions, — questions upon which dairymen differ widely. I think the more intelligent they are, the less positive that their way is absolutely infallible. Twenty-five years ago hardly a farmer in the State gave the subject a thought. If the hay crop was cut short by any means, the stock was sold off as the only way of meeting the emergency, and often at ruinously low prices. As the inevitable result, a good hay crop found them short of stock and the necessary funds to procure it. Again the competition of the great West made possible by increased facilities of transportation and the ever increasing demand for dairy products both at home and abroad, has made it absolutely necessary that something should be done. It has been our boast that there never was a demand for anything brought to the knowledge of a Yankee that his ingenuity did not supply. I believe it is true and I am confident, ay, I know, that this problem will yet be solved. Indeed, sufficient has already been done so we can safely say without fear of contradiction that one third if not one half the hay crop of New Hampshire has been fed to no purpose if not absolutely wasted. Partly because so many of the cows have been worthless for dairy purposes, partly from injudicious feeding. The old German rule that a healthy cow requires three per cent of her live weight every day in dry hay or its equivalent is substantially correct for common ones, but herds giving large quantities of milk will consume considerably more than that and must have it or they will lose either in milk or flesh and possibly in both. Last year I began a series of experiments under the suspices of the Board to determine the relative value of certain kinds of feed in the production of milk and cream. I purpose to give you the result so far as obtained.

ANALYSIS OF CLOVER HAY.

Dry fodder	85.35
Protein	11.45
Fat	2.02
Ash	5.33

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TIMOTHY OR HERD'S-GRASS.

Dry fodder	88.81
Protein	6.02
Fat	2.20
Ash	3.98

ENSILAGE.

Water	76.004
Acetic acid	.720
Sugar	1.638
Carbon, oxygen, and hydrogen	20.668
Salts or ash	.970
	100.000

In 100 parts of ash there are about as follows:

Potash	12.30	Sulphuric acid	.68
Soda	18.57	Silica	29.36
Magnesia	9.58	Oxide of iron	.61
Lime	9.68	Chloride of soda	.46
Phosphoric acid	18.76		

The cows selected to experiment with were grade Durhams, three in number, two of them being farrow, having dropped their calves early in April, and the other one fresh, calving in September last.

ANALYSIS OF MILK.

Sample A. — November 24.

New milch cow fed on good hay with four quarts cob meal and four quarts of shorts daily.

Specific gravity, 1.032.

Fat	2.021
Sugar	4.539
Casein and albumen	4.163
Salts	.552
Total solids	11.275
Water	88.725
Cost of feed	25 cents per day
Amount of milk	12 quarts
Cost per quart	.021+

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Sample B.—November 25.

Two farrow cows fed as above.

Specific gravity, 1.032.	
Fat	3.040
Sugar	4.456
Casein and albumen	4.448
Salts	.614
Total solids	12.558
Water	87.442
Cost of keeping	25 cents each
Amount of milk	20 quarts
Cost per quart	.025+

On the 26th of November the silo was opened, and the cows fed on ensilage night and morning and hay at noon, with the same quantity and kind of grain as before. On the 3d of December their milk analyzed:

Ash	.64
Fat	4.06
Solids, not fat	9.14
Total solids	13.20
Water	86.80

showing a gain in fat of 1.02 in favor of ensilage. Reckoning the ensilage at $2.40 per ton, the cost of keeping was 17½ cents per day; amount of milk, 22 quarts; cost per quart, .015 cent.

December 5 the feed was changed again. The shorts were dropped, and one quart of cob meal and one quart of cotton-seed meal fed with the ensilage night and morning, and the same quantity of hay at noon. On the 14th the milk analyzed as follows:

Specific gravity, 10.325.	
Fat	4.236
Sugar	4.270
Casein and albumen	4.525
Salts	.660
Total solids	13.691

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Water	86.309
Cost of feed per day	17 cents
Amount of milk	24 quarts
Cost per quart	.0145+

For two years past I had produced very satisfactory results from feeding molasses on corn stover, straw, and coarse meadow hay after running them through an ensilage cutter, and it was deemed advisable to test it on ensilage. I accordingly procured a barrel, which cost twenty cents per gallon delivered at Tilton, and added to their feed one half pint daily to each cow. I put the molasses directly upon the ensilage, just as it was drawn from the cask.

I wish to say right here what I forgot to say earlier. These analyses have been verified step by step, the Board as well as myself not considering it safe to base a conclusion upon one analysis or one analysis of a given sample.

After the cows were well established on the feed containing molasses the milk showed

Specific gravity, 10.315.

Fat	4.703
Sugar	4.786
Albuminoids	3.946
Ash	.601
Total solids	14.036
Water	85.964

Of the new milch cow whose milk, as I have already stated, on the 24th of November showed but 11.275 per cent solids while fed on hay and grain, on ensilage, with the same grain, analyzed 11.840 solids; substituting cotton-seed meal for shorts, 12.300 solids, and with the molasses added, only 12.84 per cent solids, which, as you all know, is less than the amount required by law when the milk is sold in the market, while the amount of fat is so small (less than three per cent) she is not profitable for a butter cow and will go to the butcher.

I presume you know something of the patient care with which all agricultural questions are studied and examined by a large class of English farmers. From the "Breeder's Gazette" I

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quote the following: "It has been a long time since we have read with more interest the results of an agricultural experiment than we have taken in the account of Lord Vernon's experiments in feeding dairy cows, submitted at the recent conference of the British Dairy Farmers' Association.

"Thirty cows, the best milkers in the herd, were selected early in January, and during the remainder of the month were given the same feed and treatment, and at the close of the month were giving an average of twenty-seven pounds of milk daily on a ration weighing with its soft food eighty-two pounds gross, containing thirty-eight pounds of dry matter, and costing ten pence per day. February 1 the cows were divided into three lots, and the rations changed to sixty-six pounds gross or 29.57 pounds dry matter, costing eight shillings and eleven and one half pence, which was continued for six weeks, at the end of which time the record showed the following average, to which the analysis of fats and solids is added:

Lot A — 26.0 lbs., 12.38 per cent solids, 3.38 per cent fats.
Lot B — 27.9 " 12.25 " " 3.28 " "
Lot C — 28.7 " 12.51 " " 3.56 " " "

It is to be regretted that in this experiment the different kinds of food are not given by name, and the relative proportion of each. I infer his herd is composed of thoroughbred animals, and consequently am not surprised that the total solids in each instance should fall below our standard of thirteen. Dr. Jenkins, one of the most celebrated milk analysts in the United States, in the Connecticut Agricultural Report for 1882 says: "In some seasons, in pure herd milk, solids may sink as low as 10 or 10.5, and the fat to 2.06, and very frequently solids are below 12." He gives the average of two hundred and eight samples as 12.40.

In Bulletin No. 22 (October, 1886) of the Massachusetts State Agricultural Experiment Station, it appears that from twelve samples milked at different dates from the cow Daisy, six were below thirteen, while seven samples out of thirteen milked from the cow Mollie were also below.

At the New Jersey State Agricultural Station out of one hundred and forty analyses representing the milk of two hundred and

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thirty cows, seventy-six contained less than thirteen per cent solids.

In Orange county, New York, a clergyman for the sake of recreation, took a small farm and stocked it with imported animals, selected mostly by himself in foreign lands, as he is a man of considerable means. Yet only a few days ago he was fined one hundred dollars after the inspection of his milk in New York, by the New York authorities, because that milk did not come up to *twelve per cent solids* (the standard in New York). There was no question about the purity of the milk. There was a herd of ten or twelve cows, and this milk was the average milk of the whole.

In an article published in the "Massachusetts Ploughman" of October 16, 1886, Prof. H. E. Alvord, of the Massachusetts Agricultural College, says: "Instances have come to my knowledge very recently of perfectly pure milk failing to reach eleven per cent solids, not in the case of a single cow, but in the case of a number of cows of one herd, and that was a pure breed of expensive animals. I myself have sampled the milk of one of the best known herds in the United States, have been acquainted with the animals, and have known of their care for twenty-four hours before I took the samples, standing over the cows myself and taking the milk from the pail very carefully and mixing it with the other milk and carrying it myself to a chemist, who made an analysis in what I regard as a perfectly satisfactory manner, and yet not one of those samples reached *eleven* per cent solids. One of the cows was considered an unusually good butter cow, and was being fed at that time for a butter test."

So I might go on almost indefinitely, quoting from the experience of the owners of the best blooded stock in this country, but I think enough has already been said to convince you that there is something beside a pedigree necessary in the dairy cow, that the animal is of more importance, in the first instance at least, than her ancestry, that care and feeding have as much to do with results as breeding.

Mr. Burnett, of Massachusetts, the well-known breeder of Jersey stock, voiced the sentiments of more dairymen perhaps than he was aware of when in his address before the New Hampshire

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State Dairymen's Association, a short time since, he said: "It is no use to try to disguise the fact that we have bred for 'points' so fine that we have nearly ruined the cow for practical purposes. We have got a pedigree as long as your arm, and a little runt of an animal with neither stomach nor constitution."

It is the testimony of such men as I have here given that leads me to repeat what I said at the start, that a thoroughbred bull or cow is not an absolutely indispensable requisite to success when you begin dairying. I would say begin with what you have. Make a study of each individual cow. Learn how to feed and care for them so as to make the most of them. By the time you have definitely settled their capabilities you will have gained from your own experience a knowledge of what is best for you to do to improve your herd that will be worth more to you than all the theories of all the men in existence. I have demonstrated to you that *milk from common cows containing four and three fourths per cent each of fat and sugar can be produced in mid-winter for one and one half cents per quart.* You can do the same. I think you can do better than that if you will try and not let one or two failures discourage you.

There are two ways in which dairying will pay in New Hampshire. One is by reducing the cost of production, the other by increasing the quantity and quality of the product. They do not run in opposite directions or at right angles. They are the two rails, if you will, of the road on which the car of success travels, and the more attention you pay to the spikes and ties the more certainly will she keep the track, and the greater the speed realized. From experiments made last winter I was led to believe a cow could be kept for fifteen cents per day in winter, and hold her flesh and milk. This winter's experiments have led me to conclude that a price considerably less than that will be reached in the near future. When I began feeding ensilage and cotton-seed meal I had a twofold object in view: first, to determine their values as feed; second, to see if they would injure the milk as milk, or affect the butter. So far the chemists have failed to discover any deleterious results from such feed, though they all tell you they don't believe it is fit to feed. Press them for a reason for the "hope that is within them," and they admit that

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they cannot demonstrate it, but it is contrary to theory. I am not a scientist, in the general acceptation of that term, so when my experience does not corroborate my theory I accept the experience and let the theory go.

Ensilage is like canned fruit, governed by the same general laws and subject to the same vicissitudes. It is no longer an experiment, though from its novelty men are disposed to experiment a good deal with it. One fact, however, is pretty generally settled among men who feed it, *i. e.*, a good quality of ensilage will produce richer milk and more of it than any other known feed for the same money. What constitutes good ensilage, is a question easier asked than answered, and yet one familiar with ensilage can tell at a glance whether it is good or poor, whether cows would do well or ill if fed on it. It does not necessarily follow that ensilage is poor because it is sour, no more than it is proved to be good because it is sweet. I have seen sweet ensilage that I should have hesitated to give my cows. Last fall I cut about one half my ensilage corn and shocked it in the field, letting it stand two or three weeks; the other half was taken immediately to the barn and run through the cutter into the silo. The former made what is called sweet ensilage, while the latter was nearly as sour as vinegar, yet I could see no difference in the feeding value. The cows thrive equally as well on the one as the other, while the milk, in taste, odor, quantity, and quality, remained unaltered. In conclusion let me say just a word; if your cows are not paying you for all they eat, and more, too, there is something wrong, either with you, or the cows or their feed, and the first thing for you to do is to go to work with a determination to find out which. That question settled, take the necessary steps to correct the evil. Never for a moment doubt your ability to succeed in what you undertake. There is no climatic reason, there is no geological or physiological reason, or any other logical reason, why New Hampshire shall not become one of the most successful dairy States in the Union. There is light ahead.

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BREEDS AND FEEDS.*

BY L. T. HAZEN.

A FEW days ago I was notified by the president of this association that I was selected to speak upon "Breeds of Cattle and Feeds," but he did not say for what purpose the cattle were designed, and we all know the breed best adapted to one purpose may not be for another. As this is a dairy meeting we will pass the Durhams, with mammoth frame, that with good rich feed will make mountains of beef, and the more symmetrical Herefords, with their white faces and beautiful forms, as well as the Polled breeds, that take on fat with great rapidity, and consider more fully the distinct dairy breeds, — the Holsteins, Guernseys, and Jerseys. Brother Goodell will tell us that the Holsteins are all that is desired and that we need not look further, and he has large ground for his opinion; but while a few breeders have produced large milk and butter records, we do not hear anything about feed or amount of milk for a pound of butter, but as he will tell all there is in their favor, I will leave them for him. A few years ago a couple of Yankees took a trip to England. While there they formed the acquaintance of an English farmer, who invited them to visit his place. They accepted and found everything very fine; but one thing they did not like. Whenever he showed them anything he remarked, "You have nothing in your country to equal that." They held their peace till they came to the dairy department, where they found all the

* Prepared for the Granite State Dairymen's meeting in January, 1887.

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conveniences that money could buy. They passed through into the storeroom, where there was a row of cheese, and with true English pride he pointed to them and said: "Did you ever put your eyes on such a fine sight? You have nothing in your country to compare with that." Human nature could hold out no longer, and one of the gentlemen exclaimed, "That isn't much; one of my neighbors makes a cheese every day that weighs a ton." Seeing the look of incredulity upon the Englishman's face he turned to his companion and said, "Isn't that so, Jim?" He said: "I don't know as I ever heard the weight of his cheese, but I was up to his place the day before I left home and saw five saw-mills being run by the whey from his cheese." I have heard that that man kept Holstein cows. The Ayrshire is an excellent breed, giving a large amount of fairly good milk, are hearty, and whoever has them will think he has the best there is. Friend Gerrish will tell us there is no use talking, for the Guernseys have all the good qualities of all the breeds combined, so I will let him tell about them, and I will speak for the only breed to keep — the rich man's delight, the ladies' pet and pride, the poor man's friend and helper, — the little Jersey, with her graceful and symmetrical form, intelligent countenance, bright eyes, affectionate disposition, rich milk, golden butter, and in the opinion of such sound-minded men as Messrs. Tallant, Daniell, and Hazen, who are known throughout New England as men of excellent judgment and sound mind, this is the only breed that ought to be kept to any extent. When we consider the wonderful tests of butter made from the Jerseys we can but wonder how any one can be satisfied with anything else, and after people have owned one or more they invariably think they have found a gold mine, and if they work it well they surely have. I have occupied too much time already on breeds, and although my heart, mind, and soul are so firmly fixed on the little Jersey that it is difficult for me to leave the subject, I feel that I must go on to that of feeds. I will first say that breeds without feeds are of little avail. I prefer a poor cow well fed to the best one poorly fed. The man who has a cow and does not feed her well is not worthy the name of man.

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Doubtless you have seen Prof. Arnold's description of feeds and their results on scientific principles. I will not go into the science of it but will briefly give my experience. When I started my dairy business I knew if I made it pay, hiring all the work done, it would require much study and thought. I would have to produce a better butter than the ordinary farmer to command higher prices. I found I must devise some means of keeping them well at a less expense than on hay and grain. I have tried nearly all kinds of feed by weighing and testing the results. There is no question but that good, bright clover hay and corn meal will make more and better butter than any other feed except grass. We cannot always get the clover hay, besides it is expensive, and corn meal is too heating to feed alone to cows that are intended for breeding. We have all heard of the Darlingtons of Pennsylvania with their four hundred cows, the butter of which is sold at one dollar a pound. They are constantly buying fresh cows of any breed, feeding very heavy with corn meal and no hay except clover, which they buy in different parts of the State. Their cows are always fat from the heavy feeding with corn meal, and as soon as they begin to reduce the flow of milk they go to the shambles and other fresh cows take their places. This practice could not be adopted by all here, and the question to answer is, What shall we feed? Two quarts corn meal, two of oats, two of bran, and one of cotton-seed in my opinion make the best grain feed for health, profit, and product. For the coarser feed, ensilage is a great saving of expense, and when properly put up will make good butter at a very small cost. I am wintering about sixty of my cows on ensilage at a cost of two and one half cents per day; with the grain feed it amounts to six cents per day. They are doing very well in milk and are in fine condition. I prefer a variety of feed, and oats cut when in the milk are an excellent feed. They will produce a large amount of milk and are a feed that every farmer should have. After regular spring work is done a few acres that will not cut much hay can be selected, plowed, and a few loads of manure scraped up, and enough oats can be raised to winter several cows at a small expense. They can be sowed any time before the first of July.

Few farmers realize the value of bran as a feed. German

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chemists tell us that at the wholesale prices of nitrogen, phosphoric acid, and potash, the manurial value obtained from a ton of bran fed to milch cows is $13.03, while our own chemists vary from $11.60 to $13.50. The manurial value of corn is only $3.34 and oats $3.80. This brings the actual cost of the bran very low if we consider the value of the manure.

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AN ECONOMIC POINT.

BY C. C. LORD, HOPKINTON.

In previous articles we have dwelt somewhat upon the economic importance of considering the obstacles to agricultural prosperity in New Hampshire. We now offer brief attention to a scientific inducement to the cultivation of such prosperity. As in the former case, so in this, we intend to follow the line of natural science. Hinderances and helps should both be contemplated with reference to the corporate law of nature, for enterprise must always pursue nature's path to be successful.

In the first aspect of the case, the majority of people in our State are obliged to work for a living. In its agricultural aspect, this living accrues from the soil. But there is a better prospect than is implied in the original statement. Scientifically speaking, a farmer works for only five per cent of his living; in other words, ninety-five per cent of his living is the spontaneous gift of nature. Let us explain what we mean.

Professor Stockbridge says that ninety-five per cent of our crops comes from the air, and five per cent from the soil. The plant-feeding organs are the roots and leaves. The leaves gather food only in the form of gas; thus its starch, sugar, oils, and gums are gathered. The real feeding-roots are the fine, hair-like threads that penetrate all through the soil. They do not feed on the soil, but absorb their food in the state of solution in water; thus they obtain their potash, silica, lime, magnesia, phosphorous, sulphuric acid, alumina, and lime. We presume that no informed person will deny the essential truth of this statement.

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But it has a further illustrative application. We have in previous articles observed that the climate of New Hampshire is comparatively a cold one. The elements of plant food supplied directly by the air are the ones that specially endow the animal system with dynamic heat. Thus we see nature has admirably anticipated the needs of man in this instance. In New Hampshire, man needs much heat which nature, so to speak, gives him for nothing.

The supply of potential heat, so abundantly provided for man by nature, is remarkable in being practically exhaustless. Wherever there is life, there is heat in store. The leaves of plants appropriate gas. This gas is principally carbonic acid gas. It is a product of the breath of animal life, of every form of combustion, and of decay. It floats everywhere that organic decomposition occurs to free the carbonic elements of natural forms. In this source of supply there is but a little liability to loss. Indeed, it is affirmed that carbon need never be applied, as a source of plant food, to the soil.

The attention which agriculture needs to give to loss is applicable to those five other parts in one hundred that crops take from the soil. In growing, crops exhaust the soil; in selling crops, the farmer reduces the five per cent of the essential elements of a living; hence it follows that unless he makes a return of soluble elements of fertile soil, ruin must result in the end. Let us look at his sources of replacement.

A portion of the fertilizing elements of the soil is relatively spontaneous; in other words, a part of the loss resulting from the farmer's operations is resupplied without labor. Floating in the air, derived from various forms of decomposition, are other than carbonaceous elements of plant growth, and which may be washed out of the air and into the soil by rains. M. Borral estimated that, by the aid of rain, there fell annually upon an acre of English land 45½ pounds of nitrogen, 103 of nitric acid, 19½ of ammonia, 12½ of chlorine, 35 of lime, and 11 of magnesia, making 226½ pounds in all.

Much of the aggregate of loss occurring by agricultural production and enterprise is resupplied from direct experimental sources. Domestic and culinary waste and animal excreta fur-

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nish an amount of fertilizing supplies that, with all our knowledge, is yet very much overlooked. The sink-drain, the vault, the yard, and the hovel yield potential supplies that are incredible to any but one who has given thorough attention to them. Let us look at one item. A few years ago, Hon. Z. A. Gilbert, of Maine, made a startling announcement that a cow will annually void 20,000 pounds of solids and an equal amount of liquids. We presume a good cow, well fed, is meant. The statement seems doubtful at first, but let a man determine for himself how much in pounds a well-fed, good cow will void in a day, and then multiply the amount by 365, and see if the result is not surprising. It is needless to deny that that much of the fertilizing resource of the direct operations of farming is lost. It can be better saved by better receptacles, better composting, and especially by better inclosures for stock. It is time to ask the serious question, if it is not better to soil the stock, saving the solid and liquid excreta for fertilizing purposes, than to allow so much ranging in pastures, incurring loss in various ways, as will appear to a thoughtful, investigating mind. In time, farmers of intelligence will be compelled to consider that, in pasture, stock treads up food, wastes manure, and browses the forest, at the same time with less profit in direct product than can be secured by proper inclosures, regular feeding and watering, and sufficient air and exercise.

However, in the practice of the strictest and wisest economy, the farmer who sells must buy. Selling the native elements of the soil in crops and produce, he must buy them back in fertilizers. We now approach a very important proposition. If the farmer cannot sell more in value than he buys, he cannot prosper. What is the source of his possible prosperity in selling and buying? In the superiority of the products of art over those of nature. It may seem strange to some to mention agriculture as an art; but it must be an art if it is to be a success in the present contingency. If a farmer must pay $30 or $40 a ton for guanos and phosphates, he must produce something as a result that is worth more than $30 or $40. Taking something and making something of more value from it, is art, and nothing else. So long as a New Hampshire farmer can rely for fertilizing supplies upon natural ones of guano and

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phosphate rock, manipulated slightly and at less cost, and can turn them into vegetables, fruits, corn, grain, beef, mutton, pork, etc., representing skilled labor and commanding a higher price, his prosperity is secure. That such a possibility is real, is shown by Hon. J. B. Walker, of Concord, in a pamphlet on "Indian Corn," asserting that fifty bushels of corn at seventy five cents a bushel, or $37.50 in the aggregate, is $26 more than the cost of the commercial fertilizers necessary to produce it, while there is also an infinitesimal profit on the fodder.

Our economic point involves three subordinate hints: First, nature has anticipated the needs of human life in a marked degree; second, man should aim to avail himself of the aids nature holds out to him; third, the products of industry should be of the best possible character, in order to more than counterbalance the value of partially spontaneous, necessary supplies. Agriculturally and locally viewed, New Hampshire farmers have a large income from nature; they should make the most of their immediate resources; their products should be of the best seed, the best blood, and the best management.

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SOILING.*

BY HON. WARREN BROWN.

AMONG the many questions which have received attention by the agricultural press, and have been the subject for discussion at farmers' clubs and institutes, I have been much surprised that the subject of soiling cattle, which is feeding cattle at the barn during the summer season when they are usually fed in the pasture, upon green food taken there for the purpose, has not received more attention and is not oftener alluded to. Certainly it is a subject worthy of our attention, and of great importance to the farmers of the New England States.

In 1819 the Hon. Josiah Quincy prepared an address upon the "Soiling of Cattle," which was delivered before the Massachusetts Society for the Promotion of Agriculture, and which has since been published in book form, and to-day is the only standard work upon the subject. He treated the subject in an exhaustive manner, proving conclusively the great advantages to be derived from the adoption of the system, and it showed him to have been very far in advance of his times as a practical and scientific agriculturist. He made the following claims as to the advantages of soiling: First, the saving of land; second, saving of fences; third, the economy of food; fourth, the better condition and comfort of the cattle; fifth, the greater production of milk; sixth, the attainment of manure. Each of these claims is supported by able and conclusive arguments from actual experiments upon his own farm and under his own practical direction,

* Read at a farmers' meeting held at New England Agricultural Hall, Boston, Mass., February 26, 1887.

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with results which proved it to have been both feasible and profitable even at that early period, when agricultural matters had received but little attention as compared with the present.

Mr. Quincy found that one acre in soiling would keep as much stock as from three to seven in pasturage, the degree of saving being varied by the kind of crops and methods of cultivation. By soiling his cattle he was able to do away with many of the interior fences about the farm, which not only gave a tidy appearance to the fields, but greatly facilitated the cultivation by the absence of head-land and bushes. The many ways in which cattle destroy food in the pasture may nearly all be prevented by feeding at the barn, and it is here that much of the economy of the system comes in. Experience has shown that many plants will be eaten in the stall which are rejected in the pasture. The cattle are kept where they are seen daily, and are under the intelligent care of the attendant, which cannot be the case when fed in the pasture. Any animal which needs extra attention can be readily seen, and liability of loss from neglect much lessened.

It was found that during the flush of feed in the early part of the season the product of milk by pasturage might be greater; yet, taking the season through, the advantage was found with the soiling system, as a continuous flow of milk could be kept up even in unfavorable seasons. One of the greatest benefits was found in the production of manure. By the pasturage system, nearly all the summer manure is lost by being dropped in waste places and by evaporation. By the soiling system, the manure is all saved, and cared for in a manner which admits of little loss. The soiling system extends from June to November inclusive. Mr. Quincy began to cut the grass along the roadsides and in the orchard on the 31st of May, and continued this till the 7th of June, when winter rye, sown for the purpose the fall before, was cured, but was found to be tough and not well fitted for the purpose, and a return to grass was had until the 6th of July, from that date until the 21st. Oats, which had been sown for the purpose, were fed then for a few days; barley was used from that time until the close of the season. Indian corn, with the tops of vegetables, formed the most of the green feed; in

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addition to the green feed, a feed of salt hay was given daily during the latter part of the season. It was found that twenty head of cattle had been fed through the season from seventeen acres.

I have been more particular in relating the details pursued by Mr. Quincy, because his methods of feeding must be very nearly followed by those who adopt the soiling system at the present time. All the circumstances which rendered the system of soiling desirable and profitable at that time exist to-day, and to a much greater degree. If it paid then, it can be made to pay much better now. The growth of cities, towns, and villages has made an enormous supply of milk necessary, and no inconsiderable portion of the farms in New England are devoted to the production of milk. This has very largely increased the number of cows kept. As the milk supply must be kept very nearly uniform throughout the year, the feed must be in the same ratio, and a great deal of care and attention must be given in order to attain the best results.

While most farmers give a great deal of attention to the improvements of the fields, scarcely any attention has been given to improving the condition of the pastures, and, from close feeding, overstocking, the effects of drought, and the want of any care, the pastures of to-day will carry much less stock than sixty years ago, and the proper feeding of cows in the pasture is a matter of great uncertainty. On most farms much more stock can be wintered than can be well pastured in the summer. On many farms more cows are kept than can be properly fed in the pastures, and a partial system of soiling is resorted to on most milk farms, and on not a few the entire system of soiling has been adopted. For the first feeding, winter rye is sown, but it is not one of the best plants for the purpose; its earliness is its greatest recommendation.

There is no better crop for feeding than grass, and a great deal may be cut about the roads, walks, gardens, and orchards which would otherwise go to waste. Upon a farm which is under a high state of cultivation the amount of feed which may be thus obtained will be found very great, and would surprise any one who has never given the subject any attention. I have some

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two or three acres of grass receiving the wash and drainage from the yards and buildings, which produces an immense growth, and will begin to lodge by the last of May, and if made into hay is of a poor quality, not readily eaten by any kind of stock, but when cut green is eaten readily. Two years ago from two acres of grass we fed twenty cows during the month of June. The first of August we commenced to cut it again, and from the two acres and two acres adjoining fed the twenty cows six weeks; in addition to the grass, one half bushel of brewers' grains was fed daily. The cows were kept in good condition, and yielded a large flow of milk. I have found clover an excellent feed for the purpose, and use a great deal of second crop in this manner. There are a great many places in the fields where enough second crop may be had for a day's feed, the removal of which is a positive benefit to the field. Those who adopt the soiling system will look closely after all such sources of feed. After the first of August, corn stalks from corn grown for the purpose will be the main dependence until the end of the season. The fodder from sweet corn is much better than that from the southern varieties. Cattle eat it much better. Even the large stocks will be all consumed. The uncertainty of growth and germination of sweet corn and the high price of seed are drawbacks on its cultivation. Since the introduction of ensilage a great help is found in carrying out the system, as an equivalent of green food is always at hand, and the providing of crops to be fed before grass can be had may be dispensed with. Where ensilage can be had there is no need of rye, which is the least satisfactory of the feeds used during the season.

No one should now attempt the soiling system unless in connection with the silo. When cattle are fed in this way, it is economy to use some grain, and a small feed daily of dry hay will be a benefit. I have used salt hay for this purpose with very satisfactory results, it being well relished by the cattle after eating so much fresh and green food. Cattle which are fed in this way should be turned out for a few hours each day, for exercise, into a convenient pasture or shady inclosure. Neglect of this will have an injurious effect, causing the animals to become stiff, with danger of losing the use of their limbs. Cattle which are fed in this

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way may, in a great measure, be protected from the annoyance of flies, which in some seasons are exceedingly troublesome and seriously reduce the profits of the animals. Upon the Wisconsin college farm an experiment was made with six cows; three were fed by the old system of pasturage, and three by soiling. One acre of pasture yielded 1,779 pounds of milk, which produced eighty-two pounds of butter. One acre in soiling crops gave 4,772 pounds of milk, which yielded 196 pounds of butter. The pasture was of the best blue grass, and would carry one cow to the acre the season through, under favorable weather conditions. This pasture was very different from our New England pastures, where it would require six or seven acres oftentimes to feed a cow, and causing much more labor for the cow to gather her food over the larger area, and which would materially reduce the amount and value of her products. If it will pay to soil in Wisconsin, it will be found still more advantageous to our farms in this part of the country.

The great want upon New England farms to-day is manure. Our soil has been very much reduced by repeated cropping, careless cultivation, and by a bad system of agriculture which neglected to return plant food to the soil, until we can no longer produce paying crops, or profit from our labor, without doing something to enrich the soil. How to get manure is the great question with our farmers. Those who live near thickly settled places may purchase; some may try to depend on commercial and special manures, which are costly, and may in the end defeat the object sought. With a great majority of our farmers barnyard manure must be the main dependence, and it cannot be had without the keeping of stock.

The best agricultural minds of the country believe that there is an intimate relation between the keeping of stock and improved agriculture, and that ordinary farms cannot long be profitable without the presence of live stock. There is no better way of increasing the supply of manure than by keeping more animals, and there is no way in which more stock can be kept so cheaply and the amount of manure increased than by soiling. The advantages of making manure in this way are, that the manure is upon the premises, with no expense for purchase and cartage; it

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can be better cared for, for we assume one who is feeding in this way has a suitable receptacle to receive and keep the manure where little will be lost by washing or evaporation; it may be moved and applied during times of leisure.

Mr. Quincy considered him a very poor farmer who had not in his time a covered receptacle for the reception and keeping of the manure thus obtained, and it is to be regretted that on many farms to-day sadly in need of manure a great deal of the manure is still allowed to go to waste. Such farmers are not likely to soil their cattle, as they are not of the kind to make successful farmers, and not easily impressed with better methods requiring more industrious habits and a larger expenditure of labor. Many may object to soiling on account of the extra labor involved. But where can labor be more profitably employed when all things are taken into account? Animals to return a profit must be well fed and cared for, and only such as receive constant attention can be counted on to do this. A full supply of food each day is absolutely necessary, and this in our climate cannot be depended on unless some provision for obtaining it has been made, and some one is in attendance to see that the animals, each and all, receive their proper share. Labor can nowhere be more profitably employed than in the production, saving, and application of manure.

Many sources of income from the farm are at the expense of its fertility, and tend to impoverish the soil, as many an old and run-down farm will attest. It is the part of wisdom to adopt such methods and sources of income when possible as will add to the productive capacity of the farm by increasing its fertility, and no better and safer course can be pursued than by the feeding of more live stock, which can be done easily and at no great expense by soiling, and thereby turning much food to good account, which under the old system would be lost. When all such feeding material is carefully saved, it will add much to the neatness and general good appearance of the premises. For two seasons I had a large number of sheep in a small pasture near home, many more than the grass growing there could feed. It was our custom daily to carry them some kind of feed. During the growing season all kinds of vegetation which we desired to

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get rid of were carried to them; weeds of all kinds, bushes, and all such things found their way to them. All such plants were eaten greedily except our yellow dock, which they utterly refused to eat under any circumstances. We got rid of much matter not wanted, the sheep were thoroughly domesticated, and the pasture was much improved, scarcely a weed or bush surviving the two years of sheep pasturage. There is no better method of reclaiming our pastures than by feeding sheep upon them in the manner alluded to above. This, although not strictly coming under the subject as announced, will tend to prove the great value of the soiling system to improve our farms. In my own practice I have found the system to work in a satisfactory manner, having fed the past season forty head of cattle by a partial soiling, giving them a daily run in the pasture. The pastures would not of themselves have carried over one third of that number. So well am I pleased, that I have no hesitation in recommending it for general use by our New England farmers where the keeping of stock is desirable.

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THE OBJECTS AND AIMS OF EXPERIMENTAL WORK WITH FERTILIZERS.

BY G. H. WHITCHER, SUPERINTENDENT AGRICULTURAL COLLEGE FARM.

ONE of the questions sometimes asked by middle-aged farmers is, Why do we hear so much about fertilizers to-day while forty years ago almost nothing was known either of bone fertilizers or of mineral products now used? This question, put in various ways, opens up the whole field of agricultural history and very largely affects future progress. I find some very curious articles in the old agricultural journals (curious in the light of to-day), which give an idea of the change which forty years have brought about.

Before giving the opinions of our own agricultural writers, I will go back almost a century and quote from an Englishman, William Strickland, who in 1794 traveled through the United States with the sole object of looking up our agricultural resources and practice. In his report to the British Board of Agriculture he says: "The course of crops in this State (New York) is as follows: First year, maize; second, rye or wheat, succeeded immediately by buckwheat which stands for seed; third, flax or oats or a mixed crop; then a repetition of the same thing as long as the land will bear anything, after which it is laid by without seed for old field; or, burn the woods, then sow wheat, second rye, then maize four or five years, or as long as it will grow, then lay it by and begin on fresh woodland. . . . A Dutchman's course on the Mohawk was: First year, wheat; second, pease;

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third, wheat; fourth, oats or flax; fifth, maize. In his father's time the crop used to be twenty bushels of wheat per acre, but he complained much now that his land only produced ten bushels."

Speaking of manure, Strickland says: "Manure is rarely made use of, but what little is collected is given to the maize which requires every support that can be given it. . . . Clover is just beginning to be cultivated. . . . The average yield of wheat in Dutchess county, which under proper cultivation would be a most productive as it is a most beautiful country, is sixteen bushels per acre . . . and it will be found that the average of this State (New York) is superior to that of any other in the Union."

This, it is true, is the opinion of an Englishman at a period when the United States had become "sour grapes," but in 1790 Washington wrote to Arthur Young that the average yield of wheat in the country was eight bushels per acre, and added by way of excuse: "In a new country, where land is plentiful and sheep and labor dear and scarce, it is more profitable to till large areas badly than small areas well."

Coming down to a more recent period, we find some very pointed advice by Judge Buel, who may be considered the pioneer in agricultural journalism in this country. In 1834 he stated things very forcibly in the "Albany Cultivator," as follows: "The method of farming that has heretofore been generally adopted in this country was to cultivate that kind of crop which gave, temporarily, the most profitable returns, utterly regardless whether by a succession of exhausting crops the soil became impoverished or not. Indeed, it was not till of late years even thought necessary to aid its fertility by such a thing as a rotation of crops or the regular application of manure. The manner was to crop it as long as a particular kind of grain could be made to grow on a given field, and when every particle of fertility was at length extracted from the soil, that lot was thrown away as worthless, a new clearing was made, and the same *bad practice* continued."

Again in 1837 Judge Buel urges the importance of a less exhaustive practice, and says: "In traveling westward we have remarked an astonishing recklessness among farmers in regard to

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their manures, the primary source of fertility. But few cattle-yards are cleaned in the spring, and many not at all. This applies particularly to the country east of Onondaga; west of that the great wheat farmers sometimes take a more summary way to disencumber their barns and yards, — they cart their straw to the fields and burn it. How long will it take to bring down the fertility of the prolific West under this system, to bring the land down to the standard of worn-out lands?" Returning now to our question, and we may say the reason why we hear so much about fertilizers to-day is, that by continued cropping and a failure to return the substances taken away the original fertility of the soil has been drawn upon until the supply is reduced below the requirements.

Perhaps we are not careful to remember that our crops are dependent upon what reaches their roots and leaves for the material from which to increase in size. Plants cannot *create* material. If a seed of corn produces a stalk that weighs five pounds, it has done this at the expense of the soil and atmosphere, and to aid us in remembering the facts in the case let us look at the composition of some crop the past year. I planted a field of ensilage corn, which was harvested from measured acres and every load weighed, so that the results are as accurate as is possible. Then at harvesting time samples were taken from the field and analyzed in the college laboratory.

The sample stalk taken September 22, 1886, gave the following analysis:

Water	79.58
Carbohydrates (starch, sugar, gum)	15.37
Albuminoids	1.22
Fiber	3.07
Ash	0.76

The yield per acre was twenty-two tons, and from the analysis I have computed the following amount of various substances that were taken away from an acre of the land:

AMOUNT REMOVED PER ACRE.

Water	35,015 pounds.
Carbohydrates (starch, sugar, gum, etc.)	6,763 "
Albuminoids (containing nitrogen 86.7 lbs.)	537 "

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Fiber	1,350 pounds.
Total ash, 335 pounds, containing	
Potash	72 "
Phosphoric acid	20.2 "
Other ash always abundant in the soil	242.8 "

Now it is evident that nothing could have been taken from the soil except what the analysis shows to have been in the crop, and it is also evident that the whole of the 44,000 pounds must have come from the soil and air, and this brings us to a consideration of the source from whence the plant gets the elements which go to make up the crop. Of course the water in the crop comes from the water in the soil, and is therefore no tax on the fertility of the land; this takes seventeen and one half tons of the total twenty-two tons out of our calculation. The carbohydrates, including such substances as starch, sugar, gum, and cellulose, and the fiber are made up of three elements, carbon (or the charcoal left after burning any part of a plant in a retort, where air cannot gain access), hydrogen and oxygen (both of which are gases and which unite to form water). In various ways it has been proven that plants may take the whole of their carbon from the air; indeed, it seems probable that they do so get the whole or nearly the whole of it. Hence we have 6,763 pounds of carbohydrates, and 1,350 pounds of fiber or cellulose, which come from the carbon in the air and the moisture of the soil, a little over four tons. Here we have, then, twenty-one and one half tons of our crop coming free to us from the air and the rain, bringing no soil exhaustion and requiring no return in manure or fertilizer. In like manner eighty-four per cent of the albuminoids come from the air and water, which, in the case under consideration, amounts to 450 pounds; or, to recapitulate, we have:

Water taken from the soil	35,015 pounds.
Carbon (from air), oxygen and hydrogen (from water), the three going to form carbohydrates	8,113 "
Carbon, hydrogen, and oxygen, forming eighty-four per cent of the albuminoids	451 "
Total from air and water	43,579 "
Whole weight of crop	44,000 "
Balance to come from soil	421 "

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Now we are chiefly interested in the composition of this 421 pounds, for we have seen that this alone comes from the soil, and it is to this that we must look if we hope to get any practical suggestions to aid in fertilizing the land for this crop. It is clearly true that if there are parts of this ash which are always overabundant in all soils, then it is useless to cause expense in applying such parts to the soil. On the other hand, if certain parts are deficient in the soil, it necessarily follows that we must furnish these parts in some fertilizing material.

The following table will show of what the 421 pounds consist:

Nitrogen	86.7	pounds.
Silica	122.0	"
Potash (K_2O)	72.0	"
Lime	37.0	"
Phosphoric acid (P_2O_5)	20.3	"
Magnesia	19.0	"
Sulphuric acid	19.0	"
Soda	11.0	"
Sulphur	11.0	"
Chlorine	23.0	"
Total	421.0	"

With the exception of the 86.7 pounds of nitrogen, the whole of this material was in the ash, and from the nature of the substances must have been taken up from the soil by the roots of the plant. We must now see if any of these are always abundant in the soil. Silica is usually present in such quantities that no attention need be paid to it; lime, also, in many sections is present in large quantities, but this is not invariably the case. A soil may be deficient in lime, and under such conditions it becomes just as necessary to apply this material as any other. Magnesia is not always overabundant, and hence may sometimes become necessary as a form of plant food to be added. It is by no means certain that soda is essential to the plant, and therefore the application of soda is unnecessary. Sulphur and sulphuric acid are in most cases abundantly supplied by the soils and it is also true that sulphuric acid is generally present in all fertilizers applied.

Johnson gives the total plant food in an acre of soil in Scot-

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land and also the amount required by an average crop of barley, and then assuming that all of this food is available (which is not true) he finds that the soil under consideration contains enough

Lime for	6,138	average	barley	crops.
Potash for	648	"	"	"
Phosphoric acid for	292	"	"	"
Sulphuric acid "	288	"	"	"
Nitrogen in ammonia for	31	"	"	"

In the vast majority of cases it is found that we need consider only the three forms of plant food, nitrogen, phosphoric acid, and potash, in a few cases lime and sulphuric acid, and in probably still fewer magnesia and chlorine.

Briefly, then, a crop of ensilage corn takes away from the soil the following amount of plant food, which needs looking after:

Nitrogen	86.7	pounds.
Potash	72.0	"
Phosphoric acid	20.3	"
Total	179	"

Hence it becomes a simple question of providing this amount of available matter in either animal manures or in chemical fertilizers.

HOW SHALL WE DETERMINE WHAT OUR SOILS NEED?

Once it was said, have a sample analyzed by the chemist and see what is present, and from this draw conclusions as to the needs of the soil. Now in theory this is all right, but there are fatal objections in practice. When a chemist analyzes a soil, he finds the total amount of potash present, and the same with nitrogen and phosphoric acid. Now it may happen that there is an abundant supply of each of these, and yet the plant may be unable to get at any, for it may be unavailable. Suppose, for example, that I take a bushel of the most barren sand that can be found, then put it in a retort and heat it until every particle of organic matter is driven off. I will then run pure water through it until I have

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washed out everything that is soluble. In this way I have got a soil as barren as a granite bowlder, and should a sample be sent to the chemist, he would return no potash, no nitrogen, no phosphoric acid. But on the other hand, I will take a portion of this sand and mix with it a few pounds of ground leather chips, five pounds of powdered feldspar, and five of powdered Canadian apatite or phosphate rock. These materials would furnish, respectively, nitrogen, potash, and phosphoric acid, and it would follow that such a sample being sent for analysis would be returned rich in each of these forms of plant food, but a plant placed in such a mixture would starve because the necessary food though present is unavailable. Now this in an exaggerated way illustrates the difficulty in the way of soil analysis, but it is by no means the only difficulty. The difference between a fertile and an infertile soil is an unweighable quantity, when we consider the small quantity of soil usually taken for analysis. Let us illustrate an extreme case; we will take an acre of land which produces but a very poor crop of grass and to an acre we will apply 100 pounds of nitrate of soda, which amount will, in many cases, produce a wonderful result. This would give $\frac{1}{27}$ of an ounce of the nitrate per square foot of surface, but only fourteen per cent of the weight of nitrate of soda is plant food, so that each square foot of surface receives $\frac{1}{190}$ of an ounce of nitrogen; but the first rain that falls after the application washes this minute quantity downward through the first nine inches of the surface, and the sample of soil for analysis would be taken from this depth. Now a square foot of soil nine inches deep weighs about sixty pounds, or nine hundred and sixty ounces, and from this we have $\frac{1}{190}$ of an ounce of nitrogen in nine hundred and sixty ounces of soil, or one ounce of nitrogen in one hundred and eighty-two thousand four hundred ounces of soil, or .0005 of one per cent of the whole soil, an amount evidently too small to be determined with any degree of reliability.

Must we give up the attempt to discover what our lands need? By no means. There is a method which is within the reach of every farmer in New Hampshire, and in my opinion it is the only way of getting at reliable, practical results. I refer to

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FIELD EXPERIMENTS.

It must be confessed, however, that thus far there is no well established and uniform method to guide those wishing to experiment with fertilizers; and while the method we have adopted is open to objections, nevertheless it is capable of giving practical if not strictly scientific results.

The original use of the various materials now so well known as fertilizers was generally the result of some accidental discovery by practical farmers. Take bone, for example. Nothing was known of it until 1750, when an English farmer made use of the waste turnings and shavings of a cerrib and button factory. A little later, 1770, Arthur Young, who made a tour throughout the north of England, mentions that in the neighborhood of Sheffield bones were used as a manure and adds: "Bones are a very odd manure, but they find them of great benefit to their clay lands, and they will last twenty years good." From the last-mentioned date until 1814, bones were either used in a whole condition or broken with sledges; but sometime during 1814 a bone-mill was constructed for grinding them finer, for it had been found that finely crushed bones produced more marked effects than coarse ones, and hence the demand for finer bones made inventors struggle with the problem of bone-mills, which continued to improve until 1840, at which time Liebig proposed to substitute sulphuric acid for grinding, a step which has done more to advance the condition of English agriculture than any other.

There was much speculation among chemists as to the cause of the action of bone. At first it was claimed that the animal matter produced the results. From the following analysis it will be seen that bones consist of

100 lbs. bone	30 lbs. animal matter containing nitrogen			2.5 lbs.
	70 lbs. ash.	58 lbs. (calcium phosphate)	Phosphoric acid	24.0 "
			Lime, 34 lbs.	
		12 lbs. other matter.		
	70 lbs.	Total plant food		26.5 lbs.

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As already stated, the fertilizing effect was first attributed to the 30 pounds of animal matter, but after a time it was found that boiled bones, from which one half of the animal matter was removed, were quite as effective as unboiled ones, and still later, that bone ash from which all animal matter was removed, proved as valuable as the whole bone. This, of course, was fatal to the animal matter theory, and in its place had to be substituted the theory that the mineral part of the ash of the bone contained the true fertilizing matter. Now, from the above analysis, it is evident that, practically, all of the ash is calcium-phosphate, a compound made up of twenty-four pounds of phosphoric acid and thirty-four pounds of lime per hundred-weight of bone. That this limited quantity of lime was insufficient to account for the increased crops known to result from the use of bone, was proven by actual trial, and it left only one compound which could be the source of plant food, namely, phosphoric acid; thus it was that soils were shown to be benefited by phosphoric acid.

Again, practice had demonstrated that saltpeter was a valuable fertilizer for wheat. This was known as long ago as 1625–50, but no records are made of its use experimentally until 1825. Saltpeter is a compound of potash and nitric acid, and, of course, the results might be due to either of these substances. To decide this matter, an English farmer in 1883 carried out the following experiment:

Three equal areas of grass were watered daily: one with pure water, another with a weak solution of nitric acid, and a third with a solution of potash. The results showed that both the nitric acid and the potash were beneficial. In this way it was shown that nitrogen, potash, and phosphoric acid are needed on exhausted soils.

SOURCES OF PLANT FOOD.

The first aid to languishing fertility in any country is animal manure. It is a standard product the world over and the more advanced the art of agriculture becomes the more carefully the animal manures are guarded that no loss may be suffered.

Of course the manure comes primarily from the food, and under varying circumstances has different value.

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Suppose, for example, that an ox weighing 1,500 pounds is standing idle, neither gaining nor losing in weight, he will require daily, according to the German feeders, 20 pounds of oat straw and 7 pounds of good hay; of course, in this case, he will consume in 365 days 7,300 pounds of straw and 2,555 pounds of hay.

The following table shows the number of pounds of water-free substance, ash, and plant food contained in this yearly supply of food:

	Dry substances.	Total ash.	Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Straw, 7,300 lbs. .	6,278	321	29.2	13.1	70.8
Hay, 2,555 lbs.. .	2,197	168	33.4	10.4	43.4
Totals . .	8,475	489	62.6	23.5	114.2

Now in this case it becomes evident that as the animal neither gains nor loses in bodily weight, the whole of the material in the food must be found in the manure, and if we can find some relation between the food consumed and the manure produced, we can get at the general composition of the whole. From the following experiment, which I made at the college farm in August, 1885, we may be able to get a few figures which will show the solid and liquid manure produced from a given quantity of food:

EXPERIMENT IN FEEDING.

August 15, 1885, a yearling bull weighing 795 pounds was put on to the following daily ration: Herd's-grass hay, ten pounds; oats, unthrashed, twelve pounds; wheat bran, two pounds. This ration was used five days, and the waste fodder weighed, also the water drank. August 20 the same bull was put on to a ration composed of hay, ten pounds; unthrashed oats, twenty pounds; wheat bran, two pounds, daily, which was continued eleven days, with the same percentage as before. In each case the solid and liquid manure was saved and weighed. The method adopted to save all liquids was to bed with a known weight of pine sawdust enough to absorb all liquids, and at the end it was only necessary to deduct the amount of sawdust to get at the exact amount of

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the animal's voidings. All of the food, the sawdust, and the manure were analyzed by Dr. R. T. Burleigh in the college laboratory with the results given in a subsequent table:

I.

TABLE SHOWING COMPOSITION OF FOOD USED.

	Water.	Fiber.	Albuminoids.	Carbohydrates.	Fat.	Total ash.	Nitrogen.	Phosphoric acid.	Potash.
Timothy hay.....	13.27	28.20	7.00	44.02	3.23	4.28	.....	0.175	0.78
Unthrashed oats.....	34.23	22.73	6.81	28.64	4.11	3.48	.....	0.14	0.51
Wheat bran..... ...	11.37	12.28	10.66	55.30	4.38	6.01	.....	1.75	0.53
Waste—unconsumed.	17.49	32.90	1.32	41.84	0.79	5.04	.....	0.18	0.44
Manure and sawdust.	78.00	.....	.....	.....	.....	2.20	0.40	0.10	0.11
Sawdust	44.39	.....	.....	.....	.....	1.00	0.16	.....	.....
Manure alone.....	82.50	.....	.....	.....	.....	2.40	0.45	0.11	0.12

II.

TABLE SHOWING FOOD CONSUMED, WATER DRANK, GAIN, ETC.

	Period.	Live weight.	Amt. Consumed.				Value of food.	Daily.					Food unconsumed.	Dry substance per lb. of grain.	Per cent of water in total food.
			Hay.	Oats.	Bran.	Water.		Grain.	Water drank.	Air dry food.	Dry substance.	Manure.			
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	
Aug. 15	.....	795	.....	.....	.....	.....	.....	...	.....	.....	...	.....	.....	.....	
Aug. 20	I.	805	50	60	10	244	$0.82	2	49	23	17.5	40	5	8.7	75.7
Aug. 31	II.	845	110	220	22	577	2.31	3.63	52.5	28	20.2	42	45	5.5	73.6

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III.

TABLE SHOWING VARIOUS CONSTITUENTS OF FOOD CONSUMED IN EACH PERIOD.

PERIOD I.—Five Days.	Amount.	Water.	Albuminoids.	Carbohydrates.	Fat.	Fiber.	Total ash.	Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Herd's-grass hay	50.	6.63	3.500	22.01	1.61	14.10	2.14	0.560	0.087	0.39
Oats	60.	20.53	4.080	17.18	2.46	13.63	2.09	0.652	0.084	0.306
Bran	10.	1.13	1.060	5.53	0.44	1.23	0.60	0.170	0.175	0.053
Totals	120.	28.29	8.640	44.72	4.51	28.96	4.83	1.382	0.346	0.749
Left unconsumed	5.	0.87	0.066	2.09	0.04	1.65	0.25	0.010	0.009	0.022
Balance taken into system	115.	27.42	8.574	42.63	4.47	27.31	4.58	1.372	0.337	0.727
Water drank	244.	244.00	.....	.....	.....	.....	.....	.....	.....	.....
Total water in ration	.....	271.42	.....	.....	.....	.....	.....	.....	.....	.....
Manure, solid and liquid	200.	165.00	.....	.....	.....	.....	4.80	0.900	0.220	0.24
PERIOD II.—Eleven Days.										
Hay	110.	14.59	7.70	48.42	3.55	31.0	4.70	1.230	0.192	0.858
Oats	220.	75.30	14.08	63.00	9.04	50.0	7.65	2.390	0.308	1.122
Bran	22.	2.50	2.34	12.16	0.96	2.7	1.32	0.375	0.385	0.116
Totals	352.	92.39	25.02	123.58	13.55	83.7	13.67	3.995	0.885	2.096
Left unconsumed	45.	7.87	0.59	18.82	0.35	14.8	2.26	0.095	0.081	0.198
Balance taken into system	307.	84.52	24.43	104.76	13.20	68.9	11.41	3.900	0.804	1.898
Water drank	577.	577.00	.....	.....	.....	.....	.....	.....	.....	.....
Total water in ration	.....	661.52	.....	.....	.....	.....	.....	.....	.....	.....
Manure, solid and liquid	468.	381.15	.....	.....	.....	.....	10.16	2.079	0.508	0.554

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Now from those tables we may learn several important lessons. Table II. shows that during the first period the animal consumed daily twenty-three pounds of food containing seventeen and one half pounds of water-free substance; in the second period he consumed daily twenty-eight pounds, containing of water-free substance twenty and one fifth pounds; but when we look at the column showing pounds of dry substance per pound of gain, the figures are reversed, and the second period is the more profitable, requiring but 5.5 pounds against 8.7 pounds in the first period.

Another point well illustrated in the same table is the per cent of water required by an animal. It must be remembered that this experiment was in hot weather, and that the demand for water was probably as great as at any season of the year. Calling the total substance taken into the system 100, and we find in the first period that of this 75.7 parts were water, and 24.3 dry substance; in the second period, 73.6 water, and 26.4 dry substance. Lawes and Gilbert lay down the rule that oxen require in every 100 pounds of food and drink, 80 pounds of water, and 20 pounds of dry substance. In either case we can readily see why animals drink so little when fed on ensilage, which usually contains from 78 to 82 per cent of water.

Table III. is important as showing what proportion of the plant food or ash of the food appears in the manure, and there are some rather difficult matters to explain in this table. In the first period it appears that the whole of the ash of the food appeared in the manure, and in fact a little more, which might and probably was due to error of analysis or of sampling; but when we come to the nitrogen, phosphoric acid, and potash, we find a very different state of affairs. The following re-statement shows the per cent of total plant food known to have gone into the system which came out in the solid and liquid manure:

NITROGEN, PHOSPHORIC ACID, AND POTASH RECOVERED IN THE MANURE.

	1st Period.	2d Period.	Average.
Nitrogen	65 per cent.	53 per cent.	59 per cent.
Phosphoric acid . . .	65 "	63 "	64 "
Potash	33 "	29 "	31 "
Total ash	104 (?) "	89 "	96 "

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Of course in a growing animal nitrogen is stored up in the increase of live weight, and so also is phosphoric acid; but it is very difficult to see where sixty-nine per cent of the potash could have disappeared, for the potash should suffer the least loss, as it is stored up in the system in very limited quantities; but such appears to have been the case. On the whole, it would appear that less than one half of the plant food in the ash of the fodder appeared in the ash of the manure, and but little more than one half of the nitrogen, so that the figures sometimes given to show the value of the manure from a given food may be misleading.

Another fact gathered from the evidence furnished by these tables is the amount of manure produced from a given amount of food. If we reduce the total food to dry substance, that is, subtract from the food consumed the amount of water contained in it, we shall find that in the first period 17.5 pounds daily produced forty pounds of manure, including the urine (Table II.). The second period 20.2 pounds of dry substance produced forty-two pounds of manure, or

Period I.,	100	lbs.	dry substance	produced	228	lbs. manure.
Period II.,	100	"	"	"	208	"
Average					218	lbs. manure.

The following results represent the investigations of three noted agricultural chemists on this same factor:

Lecouteux,	100	lbs.	dry substance	produced	250	lbs. manure.
Thaer,	100	"	"	"	230	"
Boussingault,	100	"	"	"	210	"
Average					230	lbs. manure.

Returning now to our ration of straw and hay required to maintain an ox of 1,500 pounds' live weight, and we see that he would consume in one year 8,475 pounds of dry substance, and using our factor of 218 we should expect to get 18,475 pounds of manure if all liquids were saved. Just what the weight of a "cord" of manure is no one knows, like the famous "piece of chalk." A cord of manure is a very uncertain quantity. Gregory says: "A cord of average stable manure will average in weight about 4,500 pounds." (Pamphlet on Fertilizers, page 8.)

Waring says: "As stable manure in towns is usually sold by

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the cord, I have caused a well-trodden cart-load of good livery-stable manure to be carefully weighed, and I find a cord of this manure to weigh 7,080 pounds." (Book of the Farm, page 165.)

I am fully prepared to accept Waring's figures on the manure from neat stock, and Gregory's on horse manure. Our theoretical ox, then, would produce 2.6 cords of manure from 4.9 tons of hay and straw, or one cord of manure from 1.65 tons of food in its natural state.

The manure from the above feeding experiment, the analysis of which is given in Table I., would contain in one ton and one cord the following amount of plant food:

	Pounds per ton.	Per cord of 3½ tons.	Per cord of the manure from ox fed on straw and hay.
Nitrogen	9	31.5	24
Phsphoric acid . . .	2.2	7.7	9
Potash	2.5	8.7	44
Totals . . .	13.7	47.9	77

The last column shows the plant food that would be in a "cord" of manure made by an ox on the hay and straw diet spoken of previously, and with the exception of the potash the similarity is very striking, but it still remains unsatisfactory with reference to the potash.

I have recently had six samples of manure analyzed by Mr. Allen Hazen, a graduate of the Agricultural College, with the following results per ton. (The result per cord can be readily figured by multiplying by 3½.)

SAMPLE.	Water.	Nitrogen.	Phosphoric acid.	Potash.
	Lbs.	Lbs.	Lbs.	Lbs.
1	1,661	7.2	1.11	2.24
2	1,668	9.2	2.66	4.14
3	1,656	8.8	4.00	3.22
4	1,653	8.3	4.32	3.28
5	1,664	9.8	3.32	3.26
6	1,662	9.0	3.58	3.38
Average	1,660	9.0	3.57	3.45

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These results show us that farmyard manure is in no sense the extremely rich source of plant food which we are apt to consider it, and they also tell us why we must apply such large quantities to get beneficial results. Now, when we are convinced that the supply of farmyard manure is inadequate to the demands of our farms, and we have decided to buy the elements of fertility in some form, we are at once met by the question, Where can we buy best? Commercial fertilizers, so called, have all sprung from the use of bone, first raw, afterward cut up with acid; then some material was thought necessary to furnish potash, and wood ashes were used; next, nitrogen became desirable, and either nitrate of soda, or sulphate of ammonia, or the nitrogenous guanos were used, until to-day we have a sort of standard fertilizer, varying very little among the best manufacturers, and having about the following chemical composition: Nitrogen, 3.08 per cent; phosphoric acid, 11.76 per cent; potash, 2.80 per cent. These results are got by averaging the following ten fertilizers: Bowker's, Crocker's, Chittenden's, Bradley's, Mapes, Soluble Pacific Guano, Bay State Fertilizer, Stockbridge, Cumberland, and Bay State Phosphate. Of course the value of a fertilizer depends upon two factors: first, the source of the plant food (whether or not it is available); second, the proportion in which the plant food exists.

If we take the analysis of farmyard manure already given, it will appear that the ratio between nitrogen, phosphoric acid, and potash in 100 of total plant food is about

Nitrogen	63 per cent.
Phosphoric acid	17 "
Potash	20 "

If we take the analysis of plants, which certainly ought to show us what they use, at least, and may, perhaps, indicate what they need, we shall see that the ratio between phosphoric acid and potash is as follows:

	Potash.		Phosphoric acid.
Ensilage corn (raised on college farm)	78	to	22
Northern corn " " "	73	"	27
Hay " " "	81.6	"	18.4
Manure produced " "	54	"	46
Average of ten fertilizers	20	"	80

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Now in actual field practice I have used a standard mixture of dissolved bone-black, 325 pounds; muriate of potash, 100 pounds; sulphate of ammonia, 75 pounds, giving an analysis of nitrogen, 3 per cent; phosphoric acid, 10 per cent; potash, 10 per cent, making the proportion of the latter constituents very nearly like farmyard manure, and in comparative trials side by side I have got the following results per dollar invested in the fertilizers:

1882.	Prepared fertilizers returned per $1 used . . .	$1.50
1882.	Chemicals (side by side)	2.90
1884.	Prepared fertilizers	1.64
1884.	Chemicals	2.74
1884.	Prepared fertilizers (reported by Stanton in State Grange Report, 1884)	1.56
1884.	Chemicals (reported by Stanton in State Grange Report, 1884)	3.36

I am satisfied that we need more potash, and yet our fertilizer manufacturers tell us we do not, but our soil tells us we do. Our farmers can each test this matter by buying dissolved bone-black to furnish phosphoric acid, muriate of potash to furnish potash, and sulphate of ammonia to furnish nitrogen, and they can mix them in varying proportions to see the effect. Ten per cent of potash is none too much in a fertilizer for New Hampshire, and fifteen per cent is nearer the truth.

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A TALK ABOUT GRASSES.*

BY A. W. CHEEVER.

FOURTEEN years ago this month the then best informed and most popular lecturer and writer upon dairy matters in the United States, the late X. A. Willard, of Herkimer county, N. Y., in a lecture delivered before the Vermont Dairymen's Association, told his hearers that there was a market in New York, Philadelphia, and other cities, for butter at one dollar per pound. He also quoted, with his indorsement, from a correspondent of the "New York Tribune," who had stated that there were 5,000 families in New York city who would not consider seventy-five cents per pound a high price for all the butter needed for their consumption if the quality desired could be obtained. He also quoted from Col. George E. Waring, who wrote in one of his "Ogden Farm" papers that "There need be no fear of overstocking the market with really 'gilt-edge' butter. It will always be scarce and high. Mr. Sargent, of Brookline, at whose feet I sit in dairy matters, sells his entire product to Hovey, my customer, for $1.15 per pound, and Hovey sells it for $1.25. I hope in time to equal him." Col. Waring at that time had contracted with Mr. Hovey to take a limited quantity of "Ogden Farm" butter at seventy-five cents per pound, with an expectation of higher prices. A year later Mr. Willard, speaking before the same association, again took a hopeful view of the situation and prospects of the American dairymen, from the fact that, as New York was the chief dairy State and her farms were being

* Paper read by A. W. Cheever, editor of "New England Farmer," before the Farmers' Club at Walpole, N. H.

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rapidly changed to milk, truck, and hay farms, the manufacture of butter and cheese must decrease, and the prices consequently advance. He also alluded to the comparatively limited extent of land adapted to the dairy, in soil, water, and climate, all seeming to foretell a sound, healthy condition of dairying as a business at prevailing prices, with prospect of an advance rather than a decline. Quoting from statistics, he showed that on the cheap lands of Illinois milk could not be made for less than twelve and one half cents per gallon in summer and eighteen cents in winter, and in New York and the New England States the cost must be much higher, consequently cheese must sell at fourteen cents and butter at twenty-six cents per pound to pay expenses. Mr. Harris Lewis at the same convention said: "There is no danger of the dairy business being overdone if sufficient care is practiced." Good running water, he said, was absolutely necessary for butter and cheese making. To Mr. Lewis the idea of making good butter in a country where water was pumped from wells was absurd. Mr. T. S. Gould, secretary of the Connecticut Board of Agriculture, at the same meeting, spoke of the dairy region as limited to a comparatively narrow belt, and to those sections abounding in good grasses, during the season, good running water, good temperature, and a careful, intelligent, and industrious people. The farmers attending the dairy meetings of those years were led to believe that matters had set a limit to the dairy region; that New England and a narrow strip extending but a little way west of New York comprised the territory wherein most of the high-grade dairy products of the country must always be had; and that with a little more care, they could hold the monopoly in this department, and obtain about such prices as their consciences would allow them to ask. Dollar-a-pound butter became one of the stock topics for discussion by politicians, when called upon to make cattle-show speeches to farmers. "You cannot compete," they said, "with the West in raising wheat or corn, nor in fattening beef, but if you will stock up with Jersey cows and make as good butter as Sargent or Waring makes, you can get a dollar a pound in a market that can never be overstocked. You can get rich and be independent." But in 1876 at the Centennial Exhibition in Philadelphia,

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Mr. Willard and the rest of us, who had been having great expectations, saw a Western State outside the "dairy belt" take the honors in the dairy department. The farmers of Iowa, many of them born and reared in New England, did not believe in this narrow belt theory; they had faith in good water pumped from wells. They had faith, too, in good corn stalks (poorly husked), and they quietly went to work to beat us, and succeeded, and now the creamery butter of the West is bringing the highest quoted prices and has made sorry inroads into the fancy butter trade of our Eastern cities. As a matter of fact, the amount of dollar-a-pound butter sold in all our cities has never equaled a drop in the bucket compared with the amount sold at regular quotations. Mr. Sargent's sales were often less than a dozen pounds per week, while the few other famous dairies could find a market for but a very limited quantity. There are a few farmers who still obtain prices considerably above the highest quotations, ranging from sixty to seventy cents per pound, but not one could double his supply without breaking his market.

And now the question arises, What are we going to do about it? I see but one answer. Cheapen the cost of production by adopting a better system of farming. How to farm better is a question broad enough to occupy a full course of lectures, or the attention of a farmers' club for an entire winter. It is not in agriculture alone that the profits must be obtained by the observance of little economies and small savings. Economy in production must be observed in all departments of industry, and is practiced wherever success is attained. We must grow fewer weeds in our fields, fewer bushes in our pastures, and more grass in our meadows. We must not pay interest and taxes on so much unproductive farm land. The average hay crop of the country scarcely exceeds one ton to the acre, while it requires four times as many acres as it should to pasture a cow. No farmer should feel satisfied with less than two tons of hay per acre, per year, nor with a good pasture that in a good season will not produce feed enough to summer a cow per acre, with the addition of a little grain once or twice a day.

By the best estimate I can make from the last census reports, the farms of New Hampshire average about 116 acres of improved

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land each, and keep an equivalent of six cows per farm, or one cow to nineteen acres. The value of these farms is $75,750,000, or an average of $2,356 per farm. The value of the live stock per farm is about $300, and the tools and farm machinery average a value of a fraction over $100, making the farmer's total capital in round numbers, $2,760. The total annual income of this 116-acre farm, including all that is sold or consumed, is $421, equal to a little over fifteen per cent on the capital invested, and out of which the farmer and his family must live and pay running expenses. It may interest some to learn that the expense for fertilizers per farm the last census year was only five dollars.

I must confess I do not quite like the looks of some of these figures. At six per cent it will take more than one third of the annual productions to pay the interest, leaving only about $256 to support the family and make payments on the debt, in case the farm was purchased on credit.

If the profits on farming in New Hampshire are fairly shown by the census returns they certainly offer little encouragement to the average man to run in debt for his farm; yet, if one has his farm by inheritance or marriage, as many do, I can see how he can live on an income of $421. Many laboring men in our cities find their annual income quite as small.

But what I most dislike in this view of an average New Hampshire farm is the small income per acre, only $3.63, equal to only about a third of a ton of hay at $11 per ton. To obtain this the farmer and his hired man, if he has one, have had to travel over too many acres, and too often the hired man is the only person on the farm that appears to have anything left to show for the year's labors.

Another bad feature in the showing is, that as there are many very excellent farmers in the State, who harvest large crops and make large profits, far above the average, there must be many poor fellows who are working for still smaller returns than our figures show. You have large farms in the State that are very productive, and small ones, too; you have much good land that will produce hay and pasture feed equal in quality and quantity to the product of any land in the country; and when you will

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make all your good land produce as well as the land of your best farmers you can compete with the farmers of any section, and ask favors of none.

What you need to do is to contrive to get two tons of good hay upon each and every acre of good grass land mown, because it costs no more to drive the mowing machine and the horse rake over an acre for two tons than for one ton. The profits from farming, like the profits from all other kinds of business, come from the surplus products after paying the running expenses. You know that this is true in feeding pigs, calves, colts, and dairy cows; it is equally true in feeding the crops in the corn field and the mowing lot. Better farming is called for. The old system of farming has reduced the productive capacity of our farms. We have been selling land by the quart or bushel and taking our principal to pay our annual dividends, an arrangement that sooner or later must always bring disaster, whether the business be railroading, manufacturing, or farming. It is quite time for New England farmers to adopt a better system of agriculture. We should so manage our farms as to get the most possible out of them and still leave them in better condition for our children or those who come after us than when they came into our hands.

How to do this opens a broad subject. It includes clearing from rocks, proper fencing, the erection of suitable buildings, the selection and care of live stock, and the choosing of crops to be grown. I purpose to ask your attention at this time especially to the selection and culture of grasses.

Grasses are the most universally diffused of any of the flowering plants, extending to all portions of the globe, even where the earth is bare of snow only for a few weeks in the year. The grass family includes our Indian corn and all of our small grains, but not the clovers, though as farmers we very properly call clover a grass, which it is in the agricultural use of the term.

Agriculturally, it is as proper to speak of clover hay as it is of timothy hay, or swamp or marsh hay, which may be largely composed of sedges or rushes. Nearly all our grasses have hollow stems except at the joints, which are solid. Indian corn is an exception, its stalk being solid throughout. The leaves of grass

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have a fixed arrangement, one only appearing at each node or joint, and they are placed alternately on opposite sides of the stem so that the third leaf is always directly over the first and the fourth directly over the second. The leaf consists of the sheaf surrounding the stem and the blade.

Sedges are distinguished from the true grasses by their solid sheaths, and also by the arrangement of the leaves, each of which occurs one third of the way round the stem, above or below its neighbor, instead of half way round as in the grasses. The stems of sedges are usually solid, like our corn stalks, but many of them are triangular in shape. Of all the cultivated grasses probably timothy or herd's-grass (*Phleum pratense*) is the best known. It is the favorite variety with stable keepers and nearly all horse owners. The seed is always easily obtainable in market and the cost of seeding land to timothy is less than with most other grasses, which fact, together with its wide popularity in the city markets, has made it a general favorite with the great mass of cultivators. Yet, numerous analyses show that timothy is inferior to some other grasses in nutritive constituents and many dairymen and cattle feeders have learned by experience that it is not the favorite of the animals they feed. Compared with many other grasses it is short-lived in both mowing and pasture. In pastures it is easily pulled up by cattle when feeding, and in mowings it is often destroyed by too close cutting. Under extra favorable conditions it may last many years and produce a fair second crop either for the scythe or late pasturage. I believe that the farmers of New England would find it to their advantage to make the acquaintance of a number of other grasses instead of adhering so closely to timothy. My advice is, raise less hay to sell and more to feed to your own animals, and thus keep the fertility of the farm increasing rather than diminishing. I suppose the average price of hay in New Hampshire barns is not far from $10 per ton, while in Boston market it retails at nearly double that price. Some of the best farmers of Eastern Massachusetts think they can afford to feed hay to their stock at the high price. If they can, I can hardly see how the farmers of New England can afford to sell hay at half the price.

The book-keeping farmers of Maine have demonstrated the fact

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that they can get twenty dollars per ton for their hay at home fed to dairy cows, while if sold it would net them but little over ten dollars per ton. For home feeding, redtop (*Agrostis vulgaris*) should be grown far more extensively than it ever has been, especially in Northern New England. I find some farmers never sow the seed, while not a few are entirely unfamiliar with the grass. Redtop is a finer, softer grass than timothy, a few days later in ripening, and not as quickly injured by standing uncut too long. The seed is abundant in market, and is not expensive. On moist, rich land redtop will make as heavy a crop as timothy, while on dry land it will exceed it. Analysis makes it a richer hay than timothy, and cattle and other animals generally prefer it. It, however, seldom makes a rowen crop that is worth cutting, and for this reason it is most valuable to grow on land to be mown but once a year.

Poa pratensis, June grass. Not a little misunderstanding exists in the community regarding June grass. It is applied in different localities to quite a number of different grasses which bloom in the month of June, or which are fit to be cut before the beginning of the main hay harvest. Sweet-scented vernal grass (*Anthoxanthum odoratum*), whitetop (*Danthonia spicata*), and spear grass (*Poa pratensis*) are the most common species to which the term is applied in New England. Sweet-scented vernal is a variety that is easily identified by the peculiar odor of the leaves and stems, both in the green and dry state. It is the earliest grass of value to bloom in the spring, being sometimes found in bloom in Massachusetts the latter part of May. It is this grass that imparts to some of our meadows in winter, and to the breath of our cattle at pasture in summer, the fragrance so well known to farmers, as well as to the poets who sing of the "new mown hay." It is the grass that the Penobscot Indians weave into tiny fancy baskets, to give them the perfume so attractive to visitors at Bar Harbor and other "down east" summer resorts. It is not a specially valuable grass, though it makes quite a growth of "after-feed" late in summer. It usually grows in tufts, and in this way may readily be distinguished from *Poa pratensis*, or spear grass.

Danthonia spicata, commonly known as whitetop, also as wild

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oat-grass, and old-fog, is one of the least valuable of our common June grasses. If cut early in June, cattle will eat it, but if it stands till the later grasses are grown, it is as worthless as the ripe grain straw, besides being exceedingly difficult to cut with scythe or mowing machine.

A peculiarity of this whitetop grass is in its double or triple methods of seeding, producing seeds at the top like other grasses, and also within the leaf sheath of the stem, and in the folds of the radical leaves near the root. On account of this prolificacy whitetop has rapidly increased in some portions of Vermont, particularly in permanent pastures, to the injury if not to the extinction of better varieties.

Spear grass is one of the common names of *Poa pratensis*, and is our most abundant June grass. It is identical with the famed blue-grass of Kentucky, which many suppose will only thrive in that State or upon limestone soils. It is one of the most common roadside, dooryard, and pasture grasses, and is found over a larger area than almost any other grass known. Everybody sees it, and everybody treads it under foot, though not every one knows it by name. It has spread rapidly over the country, because being earlier than timothy or redtop, with which it is often found, the seeds mature and get planted, either by falling to the ground at the roots of the parent plant, or wherever the manure may be dropped by cattle consuming it. When early and late grasses are grown together in mowing fields, the earlier varieties are the ones that hold their places and finally take complete possession of the soil. Many farmers are thoughtlessly re-seeding their meadows every year by leaving them uncut till the early varieties have ripened and shed their seeds. *Poa pratensis* is a valuable grass to sow with orchard grass to thicken the sod and fill up all spaces that would otherwise remain vacant. It has acquired a bad name in New England, because coming almost entirely from self-sown seed, and not getting well established until the fertility of the soil was pretty nearly exhausted by the growth of other cultivated grasses, few ever see it except under rather unfavorable conditions, but I have grown as heavy a crop of it as of any variety I ever cultivated. My heaviest crop was on a reclaimed meadow, where it was sown with orchard grass, and

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when the latter was killed out in an unfavorable winter. The second or third year from seeding, it was as handsome a field of grass as I ever saw, standing fully three feet high, and thick enough for more than two tons per acre.

June grass, like orchard grass, is specially valuable for its abundant leaf growth after the first cutting. It is one of the best, as well as most common, pasture grasses, and is scarcely excelled by any as a lawn grass, its dark green leaves producing the "velvety" turf so greatly admired in a lawn. But I cannot recommend it in place of timothy or redtop for ordinary mowings, nor to be sown with them. It is longer in getting established after sowing, and might run a farmer in debt the first year while other grasses would be paying a profit.

Dactylis glomerata, orchard grass. I am sorry that the character of orchard grass is not better understood. Its failings are said to be its habits of growing in tufts, and making few seed stalks, which are hard and woody; also, that when once introduced it is hard to eradicate. Other charges might be brought against it which would have equal weight in the minds of those who have learned its true value. It is not sure to live if sown late in autumn. It comes in bloom and is ready to harvest just when many farmers are busy with their hoeing and planting, and before the mowing machine has been taken from its winter quarters. The seed costs more than the seed of some other varieties. It will not live and thrive in the bottom of a pond, nor produce heavy crops on dry barren knolls. It is exhausting to the soil. I am ready to accept all these charges as true, yet I consider it one of the most valuable varieties of grass found in the United States. It grows in tufts only when sown too thin, or where there are no other equally strong growing varieties to fill up the spaces between the scattering plants. Many other valuable grasses will grow in tufts under like conditions. When a field of orchard grass is not more than half seeded, or is exhausted by repeated cropping, year after year, the blossom stalks are likely to thin, and the same is true of all other grasses of which we have any practical knowledge. An exhausted field of timothy will run up thin, and what seed stalks there are will usually be shorter than those of orchard grass. So will timothy stems be hard and woody if allowed to stand till they are over-ripe.

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Orchard grass is the earliest of our large yielding varieties, and, like all early grasses, when left to ripen sheds its seeds early, which, falling to the ground, germinate and thus the grass retains a hold upon the field. Orchard grass is difficult to eradicate just as are nearly all varieties which shed their seeds before the farmer is ready to begin his haying. A field of orchard grass is just as easy to kill by cultivation as is a field of timothy or clover. It is not like witch grass in this regard at all. It is not hardy when very young if sown late in autumn. The same is true of red clover. Both are ready to cut early in June, and if one raises a crop of either and then neglects to harvest it when ready, it is no fault of the grass. The dry, dead stems of none of our grasses make very nourishing food for stock. The seed is dearer than some other kinds, chiefly because of the smaller demand. It is much cheaper now than years ago when it was less known and less called for. But a field once well seeded, if well treated, will last many years. It will not live long under ice in winter, nor will it produce great crops on dry gravelly knolls. It exhausts the land just as does every heavy crop removed from the land. In no other sense is it exhausting. Its chief merit is in its habit of continuous growth through the entire season. It is among the first to start in spring and the last to cease growing in the fall, making it specially valuable for pasture, and for mowings that will produce two crops per year. The leaf growth, aside from that upon the seed stalks, is the most valuable portion, as is true of several other early maturing grasses. The first crop, if cut in season, makes good hay, but the glory of this grass is in its rowen crop. I have repeatedly known it to make the growth of an inch a day for a month, the broad heavy leaves, two and a half feet in length, lying so closely that unless cut at the end of four or five weeks the growth would begin to decay at the bottom for the want of air and sunshine.

Hay made of such grass, cut and cured properly, is the perfection of dairy-cow fodder. To grow it at its best, select a moist but not wet field; let it be made clean from weeds and weed seeds by a year of thorough culture in some hoed crop; sow in spring as early as the land can be well worked, or, better, the last half of July or first week in August, no later, and with no

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grain crop to interfere. Put on two bushels of seed per acre and a bushel of Kentucky blue-grass with a few pounds of clover. Harrow the seed in lightly and follow with a heavy roller. If sown in spring the field will require cutting once at least the first year, but do not cut very late, as there should be a pretty good growth left uncut to protect the plants the first winter. Be prepared the following year to begin haying as early as the middle of June, and expect two crops as heavy as can easily be made on the ground. Top-dress with fine manure, well bushed down, as soon as the second crop is taken off, or with commercial fertilizer in the spring after the grass starts to grow. Repeat the manuring every year without fail, and unless some accident befalls, as an attack of worms, two heavier crops can be cut annually than from any other seeding that I have ever tried. I have been asked, "If orchard grass is so valuable, why not raise it exclusively?" The answer is, because one would not want the entire hay harvest on a large farm to come all at once, certainly not by the middle of June. I believe in planning to have grass or other forage to cut as nearly all summer as possible. My own hay harvest usually began early in May and closed in November. My first crop was rye sown the previous fall, the last, barley sown in August.

Alopecurus pratensis, meadow foxtail, is another early grass particularly valuable for sowing in the moist portions of our permanent pastures. Like orchard grass and June grass, its leaf growth, which is continuous through the entire summer, is what makes it specially valuable above many other varieties. It is not a common grass in New England, but I believe should be better known.

Festuca elatior, tall fescue, is a valuable early grass, adapted to moist uplands whether mowing or pasture. As it ripens and sheds its seeds early, it is apt to stay when once introduced. Like orchard grass and June grass, it makes a heavy second growth of leafy rowen hay, or late fall feed. It would not be out of place sown with orchard grass or early mowing or for permanent pasture. It is a common roadside grass in many sections. Tall fescue so nearly resembles meadow fescue (*Festuca pratensis*) that the two are often confounded, if indeed they are not one and the same.

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Agropyum repens, witch grass, formerly *Triticum repens*, also called quack grass, dog grass, and many other names, a rank-growing species somewhat resembling wheat in appearance, is a grass that has some strong defenders, but more bitter enemies. It is a good grass for one to brag about who has it all over his premises and knows of no way to get rid of it. It spreads from seed, but chiefly from its underground, jointed root stocks, which can send up sprouts from every joint, and the joints are only two or three inches apart. It likes good land, and will travel to find it. When a witch grass sod is turned with the plow by ordinary methods, the land is soon green again, as though it had been untouched, the grass often growing even more thriftily for the stirring it has had. In a damp orchard, in the kitchen garden among bushes and small fruits, in the lawn, in the borders of fields surrounded by stone walls, and by the roadside, if it once gets a good foothold, it is pretty sure to stay. In the open, dry field, it is easily killed if judiciously handled at proper seasons. A densely shady crop, heavily manured, will weaken the grass very much, if it does not entirely clean it out in a single season. Corn, cabbage, and Hungarian millet are good crops with which to suffocate it. Plowing deeply in midsummer, being careful to put the sod all at the bottom of the furrow, and then harrowing the surface every few days with a harrow that will cut off every living leaf, will usually kill it. I have cleared it from a garden by careful spading-fork culture, taking pains to shake out the roots, leaving them on the surface to dry. It has been claimed that this grass would be valuable for a permanent pasture, but it will neither bear the close feeding nor the hard tramping of cattle without soon losing its apparent vigor. It grows best where it is least wanted.

There is another blue-grass besides the Kentucky blue-grass, *Poa compressa*, also called wire grass and flat-stalked grass. It starts early in spring, and yet is a late-growing variety, often producing seed stems very late in the autumn. It can be distinguished from all other grasses by its flat stem, which cannot be rolled between the thumb and finger like other grasses. It is most often seen on dry knolls, where few other varieties would thrive, and for such places, if for no others, its growth and acquaintance should be cultivated.

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There are said to be about 6,000 species of grass known to botany, but it is quite an undertaking to find much over 100 in any State in New England. Of these, only three — timothy, redtop and clover — are extensively grown by cultivation, and it is probable that these are the best that could be selected for cultivation in the ordinary system of rotating crops. They have certainly stood the test of many years' trial, and have lost none of their popularity. But there are other species which should be better known, and especially those which are adapted to permanent mowing and pasture. Many of these are found growing more or less abundantly in swales and pastures where the soil was never disturbed by plow or cultivator. The fact that these old wild grasses, as we sometimes term them, are able to hold their places, generation after generation, where our cultivated grasses would soon fail, is a strong argument in their favor, and leads us to inquire if it would not be wise for us to learn to know the best of them and to encourage their growth. Among these unplanted varieties is *Poa serotina*, fowl meadow, false redtop, a grass much resembling common redtop. It is found most frequently in meadows bordering streams, the seeds doubtless being disseminated by overflowing waters. It is finer than common redtop and retains its green succulent condition even after the seed is ripe, making it a specially valuable grass for farmers who are ever behindhand with their work. The seed is found in our markets in limited quantity but sufficient to enable those having suitable land to give it a trial. I have seen most successful experiments with it upon partially reclaimed meadows.

Deyeuxia canadensis, blue joint grass, small reed grass, formerly known as *Calamagrostis canadensis*, is a worthy grass to be encouraged in wet meadows. It grows from four to five feet high, has considerable leaf growth, is nutritious, and is eaten with a relish by all kinds of stock.

Phalaris arundinacea, reed canary grass, is a coarser and taller meadow grass that will grow where the soil is nearly saturated with water, and will produce very heavy crops. Botanists say this grass is identical with the ribbon grass of our gardens, a statement I am unable to deny. Opinions differ widely regarding its value for hay, which depends very much, probably, upon the time

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of cutting and the way in which it is cured. Chemists find it very nutritious if cut in the bud.

There are thousands of acres of low swale or marsh lands that are now producing only inferior varieties of grass, or sedge, which might be greatly improved by sowing the seeds of these better kinds. Children can be easily taught to distinguish the valuable varieties, and could earn good wages saving the seed at the proper time for gathering. Many of these grasses, if introduced upon the upper portions of swales, would in a few years spread over large tracts, the seed being naturally carried down stream in times of high water.

Many pastures might be greatly improved by scattering the seeds of the better varieties of our native grasses over them early in the fall, and if the surface could be scarrified with a fine-toothed harrow at the same time, and some fertilizer applied, success would be almost assured.

TIME TO SEED.

It is possible for grass to do well from seed sown any month or day in the year. Yet all seasons are not equally favorable. Nature plants the grasses chiefly in the late summer or early autumn, soon after the seeds are matured, and under favorable conditions the seeds germinate and the young plants make considerable growth the same fall. Clover seed left to nature's care is protected by its covering of husk from germinating till the following spring. We are not required, however, to follow nature closely in all our agricultural operations, but it is well to observe her so closely as to have a clear understanding of her methods, that we may sufficiently conform to them, and thus secure desired results. Some of our grasses are so hardy that they will live through the winter under favorable conditions, even if the seeds have scarcely more than germinated. Cold alone will rarely kill young timothy or redtop, yet if sown where the ground is exposed to alternate freezing and thawing, so that the plants are pulled up and left with their roots exposed upon the surface to freezing and drying, they will most surely perish.

Were it not for the depredations of grasshoppers and crickets, I should name early autumn as the best time in the whole year

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for sowing most varieties of grass seed, the precise time to be determined each year by the condition of the soil and the character of the weather. On rich land too early seeding may give too much growth the first season. Grass roots need the protection of their own leaves, but it will not do to smother the plants under too heavy a mulch of rank leaf growth. The favorable period is from the last of July to the middle of September. If sown later, the ground should be rich, the season favorable, or some kind of grain crop like winter rye put in with it as a protection. Two bushels of rye to the acre with late-sown grass will make a root growth that will help hold the soil together, and a top growth that will tend to keep the sun from thawing the surface when bare of snow. If the rye is cut early the following spring, and used for feeding cattle before the pastures are ready to turn into, it will not materially injure the young grass, but to let grain crops stand to ripen, to be cut in the heat of midsummer, is quite another matter; their later growth shades the grass too much and too long, and makes it grow slender, while the roots of the stronger growing grain seriously exhaust the soil of both moisture and fertility. If grass is the crop most desired, I would never risk sowing it with small grain except under such conditions as I have named. The advisability of seeding in spring with grain will depend upon the relative importance of the crops and the character of the climate. In Northern New England, where the seasons are comparatively short and cool, and where the spring-sown grain is not cut till quite late in the fall, spring seeding is usually safe; but in Massachusetts and farther south, where the grain is cut during the heat of midsummer, the risk is very great, and our best farmers are gradually abandoning the practice. Some who have tried spring seeding without grain have found their land so foul with annual weeds that the grass has had quite as hard a chance with weeds as it would have had with grain, so they have gone back to seeding with grain, or more generally have given up spring seeding entirely. Were our tillage lands free from weed seeds there would be little difficulty in getting a good "catch" by spring seeding, but as most lands are, it is quite otherwise. Most of our troublesome weeds are annuals that start early, grow fast and strong, and easily overshadow and overpower

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the tiny grass plants. When grass is sown in autumn, the young plants expend their forces in making a strong root growth, and in producing numerous short, stocky, low spreading leaves. Fall-sown grass, like fall-sown rye or wheat, tillers and spreads, but never makes an effort at producing seed stalks the first year. The vigorous fall growth is a storing up of strength for producing stems and seeds the following year.

Timothy is a bulbous biennial much resembling an onion. It is as unnatural for the one to seed the first year as for the other, and we make a mistake when we make the conditions unfavorable to the full development of either. The onion requires, practically, the whole of the first growing season to perfect its bulb, while the timothy plant will do well if it has but the last half of the season. Another illustration may be found in the beet and turnip which make bulbs one season and produce seeds the next. The beet needs most of the summer to make a good bulb, while some varieties of turnip will make it in the fall from August sowing. If we sow beet seed early in spring three or four hundred miles to the south, we may find a large portion of the bulbs throwing up seed stalks the first summer. So if we sow timothy seed in spring in our climate we are giving it unnatural conditions; it finds everything favorable to rapid growth and it will often send up its seed stalks the first summer. But such growth being unnatural the plants are likely to be short-lived. I have seen spring-sown timothy as completely killed by cutting the first summer as if it had been an annual, like oats or barley. Red clover is classed among the biennial plants, as it usually makes no seed the first year, but if we sow the seed early in spring with no stronger growing plants to keep it back it will often bloom and produce seed the first year, and very likely die the first winter. It has been changed from a biennial to an annual. We may well look upon timothy and some of our other valuable meadow grasses as approaching in their character biennial plants, and we will do well to treat them accordingly. Our onion bulbs are taken in and protected under cover in winter, but timothy being somewhat hardier than the onion is left ont in the field, yet its bulbs need some protection. It is one of our tenderest grasses, as farmers well know who find it con-

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stantly diminishing in their fields, while its place is being filled by less valuable varieties. The best protection is the stubble and leaves left by the machine or scythe when cutting. Close cutting is almost sure death to timothy. A good top-dressing of stable manure is also a good protection and the sooner it is applied after a crop is removed the better it will be for the next crop.

And this leads us to the question of top-dressing mowings. This is a perennial question. Much depends upon conditions and circumstances surrounding each inquirer. Very much depends upon the condition of the sod and the general character of the soil. Moist, stony land that is well covered with grasses of good quality may often be top-dressed with marked economy. Indeed, it may be the only practicable method of treating it. One who owns a large area of such land is quite inclined to believe that top-dressing is the true and about the only method of treating all mowing-fields, while the owner of a dry, sandy plain may count one as foolish who would thus waste manure, as he looks at it.

We are apt to accord to grass more of a perennial character than is its due. A mowing-field, it is true, may remain a good mowing-field ten, forty, or a hundred years, but the individual grass plants may have been many times replaced or renewed, like the ever-changing population of a city or town. Timothy grass actually renews itself every year, not from seed but from offsets at the root, or more strictly at the bulb. Timothy grown upon dry land and cut for hay in a dry period is usually killed outright, and its place taken by other grasses or weeds. On moist land, or in wet seasons, the little offshoots at the base of the old bulb usually take root and are able to support themselves before the parent bulb dies of old age, and thus our meadow is renewed, though it may be not a timothy plant exists that was alive two or three years ago.

Top-dressing helps timothy by adding something to the surface into which the roots of the new bulbs may readily penetrate for their plant food. Top-dressing in this case is like "hilling up" about a tomato plant to encourage roots to push from the stem, or like preparing a loose, rich soil for strawberry runners to root in.

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Red clover renews itself only from seed, but white clover from the roots or layers. June grass and witch grass both spread from underground stems. If our grasses were allowed to stand late enough, they would all renew themselves from seed, but good husbandry requires cutting too early for this.

The proposition is conceivable of a timothy meadow kept vigorous and clear from other grasses for a term of years by annual top-dressing, but such meadows, if existing at all, are exceedingly rare. They are not found on dry soils, and timothy is not a natural grass for wet land.

Whoever would attempt to keep a permanent meadow by top-dressing, should select other grasses than timothy for his sod, unless he scatters seed freely with the manure applied. Redtop, or other so-called natural meadow grasses, will be likely to be found in all good mowings that can be kept productive for a long period by the application of manure to the surface. Nature will help us in our selection of varieties, if we will study the character of the grasses found in good mowings that are kept rich and productive by annual flowage in the spring.

TIME TO TOP-DRESS.

I believe the best time to top-dress is the next day after the hay is cut and removed from the field. The manure then acts as a mulch to shade the surface and protect the roots, and also by affording a fresh supply of plant food, which will be washed into the soil by the first shower or rain-storm.

But I would not give much thought to top-dressing except upon such lands as will produce at least two good crops of hay every season. Manure applied just after haying makes the second crop almost an assured fact every year on lands and sod adapted to permanent mowing. The next best time is in the spring just as the grass is starting into vigorous growth, provided the soil is firm enough to cart over at that time, as it will be if it is properly drained.

Manure for top-dressing should either be so thoroughly rotted and fine that it will readily sift down in amongst the stubble, or it should be so soft that a heavy bush, or a smoothing harrow, or

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drag, will spread it all down close to the earth. Manure applied in lumps left to dry on the surface is worth very little as top-dressing.

I have never seen better results from top-dressing than when I have drawn out manure fresh from the barn cellar, and so soft that a bush drawn over the ground the same day would apparently leave nothing but a heavy manure stain upon every inch of soil and every spear of grasss. The first rain gave the crop a heavy dressing of liquid manure.

I would prefer to give such a dressing twice a year, first in May and next in July, after cutting the first crop; but to save labor, one larger application might be more economical. This method is specially applicable to what we commonly term natural grasses. Timothy might be injured in dry weather by drawing a heavy brush or harrow over the stubble.

Fine mauure, even if heavily extended with loam or other soil by composting, might be better for timothy on dry uplands, although I do not advocate top-dressing dry land at all.

Fertilizers for top-dressing present some of the same difficulties which attend the use of stable manure, and a lack of some of its benefits. Fertilizers have no use as a mulch, nor do they add to the amount of the surface soil in which the young surface roots must feed. We find the same tendency of the earlier grasses to take possession of the land and crowd out later and better varieties.

We are apt to speak of mowing-land in this condition as "bound out," which simply means that June grass has filled the soil full of roots, and this grass is not much of a cropper as ordinarily treated.

I know of men owning farms which they have wished to handle at a profit, but with as little labor as possible, who have had the strongest faith in commercial fertilizers, and have used them extensively for top-dressing permanent mowings, or mowings which they had hoped would be permanent, but I have known of no instance where ordinary tillage land has been thus treated without bringing disappointment sooner or later.

"Bound out" — the timothy all gone and June grass in its place — is the common complaint, but a bad winter or white

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grubs in summer often bring the experiment to an abrupt termination; and the land must be plowed and re-seeded, either directly, or, what is far better as a rule, after a cultivated crop.

Land long in grass becomes after a while, under the pressure of teams and cart-wheels, too hard and compact for the best growth of the plants. The surface sheds rather than absorbs the showers as they fall, and moisture goes off into the brooks and is lost to the field. There is also, as is claimed, a shutting up of the capillary air spaces through which moisture is brought up from the subsoil in a dry time to sustain surface vegetation. This is undoubtedly true to a considerable extent, as shown by the sensitiveness to drought of a much-trodden pasture or a dooryard walk.

Another objection to continuous top-dressings for mowings, is the growing of one kind of crop continually without rotation, a system which must be attended with more or less waste. We may fill our soil with certain elements of plant food which the grass crop cannot return to us but which would be returned in an occasional crop of clover or roots. This fact must explain in part why so many farmers who have experimented in top-dressing have come to the conclusion that one load of manure worked into the soil is worth two spread upon the surface. They apply only a moderate dressing, for a corn crop, for instance, and after the corn, get a heavier crop of grass than they would have expected had they applied the same amount of manure to the old sod direct.

We hear much said, and properly, too, of the mechanical effect of manure in the soil, but there is little or no mechanical effect to be looked for from surface application on grass. Theoretically, there is no waste by the exposure of manure on the surface, but, practically, I believe there may be. I have spread manure on plowed fields in the autumn and left it exposed all winter, and found the cultivated crops the following summer quite as heavy as where the same amount of manure was applied in the spring immediately before planting. On the other hand, I have spread a top-dressing on grass land in the fall, leaving it in a somewhat lumpy and uneven condition, and have failed to see much benefit from it the summer following, or any time afterwards.

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In treating this subject of top-dressing I might have simply stated that, in my own farm practice, top-dressing grass lands had not been attended with satisfactory results. But some one else might have replied and said that top-dressing had always paid him; and he was convinced that it is the true way to raise grass. Then, there would have been simply the opinions of two, looking at a subject from different standpoints. I have endeavored to discover some of the reasons *why* different farmers arrive at opposite conclusions as a result of their several experiments.

My conclusion is, if one has natural grass land, which is too stony to plow and not worth the clearing, this top-dressing *must* be resorted to, for it is the "Hobson's choice"; but if the land is tillable, or can be made so by a reasonable outlay, then apply the manure to cultivated crops and work it into the soil, and get the grass in rotation. If it is thought desirable to top-dress a few times to retain the grass longer, then by all means apply the top-dressing while the valuable grasses are still vigorous, instead of waiting till there is nothing left worth top-dressing; for manure, unless it is well stocked with good grass seed, cannot restore a mowing from which the best varieties are all starved out. Much depends upon conditions and circumstances surrounding each individual, and each must be governed accordingly in practice. We may well remember, however, that principles never change.

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AGRICULTURAL FAIRS.

In addition to a state fair, about the usual number of county, district, and town fairs were held during the autumn of 1886. The agricultural report would very properly contain a brief account of each, but we are able to present in this volume only the reports of the following, furnished by Dr. W. H. H. Mason, member of the Board from Carroll county:

THE STATE GRANGE FAIR AT TILTON.

As delegate of the Board of Agriculture, I attended the Grange fair at Tilton, September 29–30 and October 1. This was the first annual state fair and festival held under the auspices and direction of the Grange, but we hope it was not the last. Every one interested in agricultural fairs has reason for gratitude to this organization for the example set in the manner of conducting this fair. It is doing no injustice to any previous fairs to say that it was the best exhibition of the kind ever held in the State. The grounds were well arranged, and the display of stock, farming tools, agricultural products, and handiwork was of the highest order.

It was a novelty, inasmuch as it was what it purported to be, a strictly agricultural fair, free from the objectionable features of fairs in general. No kinds of intoxicating drinks were allowed on the grounds or environs; no gambling, no horse racing, and no disturbance of any kind. The example set by this exhibition must have a highly favorable effect on future fairs in the State in morals as well as in the farming interest.

The farmers of New Hampshire are under great obligations

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to the Grange. They are doing a good work and it is hoped that in conjunction with the Board of Agriculture they will continue to sustain and increase the farming interest. I learn that this exhibition is to be repeated at the same place the coming season. It will be anticipated with great interest by every lover of farming and of wholesome and moral exhibitions. There was a lack in the ability to feed the vast multitude which was the only fault. This, it is expected, will be remedied at the next show.

GRAFTON COUNTY FAIR AT PLYMOUTH.

Agreeably to appointment, I attended the agricultural fair at Plymouth, held September 1, 2, 3, 1886. On entering the grounds, I was pleased to notice the absence of drinking-stands, gambling-tables, and other objectional features which have in many instances been a curse in previous years to New Hampshire agricultural fairs. It is gratifying to know that the cause of temperance has had its favorable effect in these exhibitions, and we have reason to believe that henceforth the evil effect of liquor selling and gambling will be strictly prohibited by the managers of our fairs. I saw no one intoxicated nor any indication that liquor was sold in or around the grounds. There was a very fair exhibition of stock, notably, Short-horns, Devons, and natives, by C. W. Pulsifer, of Campton. Among other exhibitors were C. H. Cutter, of Plymouth; F. C. Cummings, of Holderness; H. H. Bailey & Son, Alexandria; A. H. Cook, of Campton; S. M. Spencer and Edgar Merrill. I have not place here to give particular description of each and can only say that each exhibitor had good specimens, all in good condition. There was no display of high-fed fancy stock, but the show was made up of representative stock from the barns of the farmers in the vicinity. C. Whittemore, A. C. Moulton, and H. H. Bailey made a good show of working cattle. Thornton, Campton, and Rumney sent town-teams, which made a good display. They all looked so well that I did not try to decide which was best. D. W. Gibson, of Plymouth, made a fine display of steers, together with H. H. Bailey, of Alexandria. There was not a large exhibition of agricultural implements. Floral hall was well

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filled with the handiwork of the ladies. There was also a good display of grains, fruits, and dairy products. It was a good exhibition and I think gave general satisfaction.

TOWN FAIR AT SANDWICH.

Sandwich got up a town fair upon short notice and under great inconvenience and embarrassment, inasmuch as they had no convenient ground for the display. The people at an early hour began to pour into the Center village until there was hardly room for the immense crowd. Farmers from all parts of the town came with big oxen until they had 150 yoke in line, and would have made a magnificent show if there had been sufficient room. It was very hastily gotten up, but it gave immense satisfaction and shows what Sandwich can and probably will do at some future time. Sandwich is noted for its hay crop, pasturage, big cattle, and general industry. The meeting was addressed by Judge L. D. Mason, Judge Hill, Dr. W. H. H. Mason, Col. Fellows, and Paul Wentworth, Esq.

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PATRONS OF HUSBANDRY.

Officers of the New Hampshire State Grange, 1887.

Charles McDaniel, Springfield, *Master*.
Charles N. Clough, Canterbury, *Overseer*.
John D. Lyman, Exeter, *Lecturer*.
Frank H. Weld, Cornish, *Steward*.
James E. Shepard, New London, *Assistant Steward*.
George L. Dascombe, Wilton, *Chaplain*.
Jonathan M. Taylor, Sanbornton, *Treasurer*.
Nahum J. Bachelder, East Andover, *Secretary*.
James M. Williams, Bath, *Gate-Keeper*.
Mrs. Charles McDaniel, Springfield, *Pomona*.
Mrs. Oscar E. Sargent, Chesterfield, *Flora*.
Miss Addie E. Rice, Henniker, *Ceres*.
Mrs. Kimball Webster, Hudson, *Lady Steward*.

Executive Committee.

Charles McDaniel, Springfield, *Chairman*.
Nahum J. Bachelder, East Andover.
William W. Burbank, Webster, *Secretary*.
Robert D. Gay, Manchester.
John W. Farr, Littleton.

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LIST OF THE SUBORDINATE GRANGES.

No.	NAME.	LOCATION.	MASTER.	LECTURER.	SECRETARY.
1	Gilman.	Exeter.	John J. Bell.	C. W. Treadwell.	John D. Lyman.
3	Amoskeag.	Manchester.	Adam Dickey.	A. B. Paige.	Benj. J. Mack.
4	Merrimack River.	Canterbury.	Millard F. Emery.	Charles W. Emery.	Mrs. C. W. Emery.
5	Lovell.	Washington.	Wakeman J. Powers.	Miss Ida M. Chapin.	Mrs. Mary J. Chapin.
6	Halestown.	Weare.	Miss Henrietta Clement.	Mrs. J. E. Jones.	Mrs. R. M. Jameson.
7	Granite.	Milford.	William R. Howard.	W. Wells Howard.	George W. Colburn.
8	Sullivan.	Newport.	L. L. Cutts.	George H. Whitney.	George W. Hurd.
9	Claremont.	Claremont.	Erastus Reed.	Mrs. Louisa M. Buckman.	Dudley T. Chase.
10	Souhegan.	Amherst.	A. Milton Wilkins.	C. L. Trow.	Miss Mary F. Hazeltine.
11	Hudson.	Hudson.	William A. Andrews.	George H. Abbott.	Kimball Webster.
12	Hollis.	Hollis.	Charles E. Hardy.	Mrs. Louisa D. Spalding.	James C. Hildreth.
13	Nashua.	Nashua.	Howard E. Priest.	Colman W. Murch.	Albert H. Bailey.
18	Pinnacle.	Lyndeboro'.	J. A. Woodward.	Mrs. E. C. Curtis.	John H. Goodrich.
19	Cold River.	Acworth.	Chester M. Johnson.	Miss Nora M. Allen.	Myron D. Clarke.
20	Advance.	Wilton.	Willis H. Abbott.	A. Dwight Abbott.	Mrs. A. D. Abbott.
21	Prospect.	M'nt Vernon.	George H. McQuestion.	Miss Susie M. Kendall.	Miss Eunice A. Fox.
23	Greenfield.	Greenfield.	David Starrett.	Mrs. John Fletcher.	Mrs. A. W. Savage.
25	Cornish.	Cornish.	Lemuel Martindale.	Mrs. W. E. Westgate.	Mrs. Albert Weld.
31	Thornton.	Merrimack.	James C. Hodgman.	Mrs. Clara K. Foster.	Miss Clara S. Kittredge.
32	Oak Hill.	Francest'wn.	Henry Richardson.	Mrs. Emma H. Colburn.	George F. Pettee.
33	John Hancock.	Hancock.	Clarence H. Ware.	Miss Lettie W. Goodhue.	George W. Goodhue.
34	Miller.	Temple.	D. C. Bragdon.	Martin H. Fiske.	W. P. Bacon.
35	Peterborough.	Peterboro'.	Albert O. Smith.	George W. Marden.	Miss Jennie S. Marden.
36	Watatic.	New Ipswich.	Frank W. Prichard.	C. H. Obear.	Charles A. Preston.
37	Nutfield.	Derry.	Fred H. Bartlett.	Mrs. Lizzie F. Hill.	A. L. Mellen.

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39	Bear Hill.	Henniker.	Josiah W. Emery.	James Fellows.	W. H. M. Cate.
40	Uncanoonuc.	Goffstown.	J. G. Taggart.	George P. Hadley.	George B. Stevens.
41	Wolf Hill.	Deering.	George F. Gove.	Miss S. M. Bailey.	Mrs. D. B. Gove.
42	Stark.	Dunbarton.	Thomas W. Kimball.	A. P. Chamberlain.	Mrs. N. H. Barnard.
44	Londonderry.	Londonde'y.	Daniel G. Annis.	Miss Mary A. Wiley.	Charles H. Fling.
46	Narragansett.	Bedford.	Edward W. Stevens.	Mrs. N. B. Hull.	Willard C. Parker.
48	Lancaster.	Lancaster.	W. R. Stockwell, Jr.	James Bain.	R. F. Carter.
49	Monroe.	Monroe.	Daniel Sherry.	Hugh Nelson.	R. A. Moore.
50	White Mountain.	Littleton.	William Harriman.	George C. Furber.	Mrs. C. R. Allen.
52	Mount Belknap.	Gilford.	Thomas E. Hunt.	William H. Weeks.	Mrs. T. E. Hunt.
53	Joe English.	New Boston.	Charles S. Colburn.	Mrs. H. D. Gould.	Roger H. Vose.
54	Wyoming.	South We're.	Charles J. Hadley.	Josiah H. Nichols.	Mrs. Ellen A. Gould.
55	Ammonoosuc.	Bath.	M. R. Tewksbury.	J. M. Williams.	Mrs. A. P. Prescott.
56	Union.	Hopkinton.	Herbert M. Kimball.	Mrs. H. M. Kimball.	Mrs. J. M. Connor.
58	Bradford.	Bradford.	Frank O. Melvin.	George I. Rand.	Miss Emma B. Felch.
60	Grafton Star.	Hanover.	C. H. Pettee.	C. W. Scott.	J. M. Fuller.
62	Morning Star.	Lyme.	George S. Mayo.	Bela Sawyer.	John F. Elliott.
63	Valley.	Hillsboro'.	Mark M. Hadley.	William E. Gay.	Edgar Hazen.
65	Crown Point.	StraffordCor.	Frank B. Yeaton.	Fred T. Stanton.	Charles F. Felker.
68	Mascoma.	Enfield.	Fred G. Richardson.	John C. Currier.	Mrs. Ruth K. Jones.
69	Eureka.	Grafton.	B. Frank Williams.	George S. Barney.	Miss Lizzie A Fowler.
70	Mont Calm.	Enfield Cen.	Charles McDaniel.	Mrs. Ella R. McElwain.	Allen H. Jackman.
71	Blazing Star.	Danbury.	Ebenezer E. Wells.	Mrs. Almira E. Bullock.	John D. Danforth.
72	Indian River.	Canaan.	C. O. Barney.	Miss Roxie L. Davis.	Miss Dell E. Barney.
74	Deerfield.	Deerfield.	Arthur M. Chase.	Edmund T. Chase.	George H. Stevens.
77	Mount Hope.	Landaff.	John E. Hall.	Mrs. John E. Hall.	W. C. Clark.
79	Olive Branch.	Hebron.	David P. Hardy.	E. K. Follansbee.	Albert E. Moore.
80	Bow Lake.	Strafford.	John O. Boody.	Mrs. L. C. Culchett.	D. S. Woodman.
81	Cocheco.	Dover.	Martin L. Lord.	James M. Hayes.	Mrs. Minnie F. Hayes.
83	Spafford.	Chesterfield.	Herman G. Smith.	John L. Streeter.	Mrs. W. W. Foss.
86	Rochester.	Rochester.	Dudley B. Waldron.	Mrs. Carrie E. Springfield.	I. W. Springfield.

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LIST OF THE SUBORDINATE GRANGES (*continued.*)

No.	NAME.	LOCATION.	MASTER.	LECTURER.	SECRETARY.
87	Kearsage.	Wilmot.	John M. Carr.	Mrs. L. M. Nelson.	A. J. Cheney.
88	Highland Lake.	Andover.	E. B. Merrill.	F. H. Flanders.	Mrs. F. H. Flanders.
90	Warner.	Warner.	Philip C. Wheeler.	J. R. Cogswell.	Miss Fanny H. Corey.
91	Sutton.	Sutton.	Charles A. Fowler.	Mrs. Lydia M. Putney.	Daniel L. Powers.
93	Campton.	Campton.	Mark Spokesfield.	Thomas S. Pulsifer.	Walter H. Dow.
94	Ezekiel Webster.	Boscawen.	Charles N. Clough.	David F. Dudley.	William P. Abbott.
95	New London.	NewLondon.	Charles W. Gay.	Nathaniel C. Todd.	W. M. Knowlton.
96	Forest.	Stoddard.	Herbert E. Proctor.	William H. Chase.	Charles A. Whittemore.
97	Catamount.	Pittsfield.	Frank E. Cram.	George R. Drake.	Mrs. George R. Drake.
98	Antrim.	Antrim.	Ansel S. Buchanan.	Ira Hutchinson.	George T. Buchanan.
99	Harmony.	Sanbornton.	Alfred H. Colby.	Herbert J. L. Bodwell.	George C. Ward.
100	Daniel Webster.	Webster.	Warren Abbott.	Mrs. Addie M. Hoit.	F. A. Lang.
101	Crystal Lake.	Gilmanton.	John L. Piper.	Thomas Cogswell.	Miss Cora B. Gale.
102	McClary.	Epsom.	James W. Fowler.	Mrs. Jennie Noyes.	Miss Annie Tripp.
103	Monadnock.	Dublin.	Henry D. Learned.	Warren L. Fiske.	Miss Sarah F. Townsend.
104	Bartlett	Salisbury.	Thomas D. Little.	George E. Fellows.	Andrew E. Quimby.
105	Silver Lake.	Harrisville.	Thomas H. White.	Fred C. Farwell.	Mrs. Mary E. Parker.
106	Fruitdale.	Mason.	Orren A. Hamblett.	George W. Goddard.	Timothy Russell.
107	Pemigewasset.	Hill.	Rev. E. H. Wright.	Silas P. Thompson.	J. W. Favor.
108	Franklin.	Franklin.	Wallace Burleigh.	J. H. Rowell.	George P. Gale.
109	Rumford.	East Concord	John G. Tallant.	Charles H. Sanborn.	Frank P. Curtis.
110	Friendship.	Northfield.	George R. Locke.	L. F. Batchelder.	Miss Belle W. Gile.
111	Pembroke.	Pembroke.	Joseph H. Dearborn.	Crosby Knox.	Frank W. Stevens.
112	Sunapee Lake.	Newbury.	Fred S. Muzzey.	Mrs. Amanda M. Peaslee.	Nathan B. Bly.
113	Capital.	Concord.	W. W. Critchett.	Rev. A. C. Hardy.	William P. Ballard.

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114	Golden Rod.	Swanzey.	Charles H. Rockwood.	Benjamin Read.	Mrs. Annie G. Hills.
115	Granite Lake.	Nelson.	Frederic Taylor.	James H. Scott.	Frank R. Jewett.
116	Mt. Washington.	Whitefield.	James A. Goodwin.	Mrs. James A. Goodwin.	Fred A. Shute.
117	Lawrence.	Belmont.	Isaiah Piper.	Edwin C. Bean.	Joseph B. Mathews.
118	Marlborough.	Marlboro'.	Charles Mason.	Charles H. Thatcher.	Philip F. Peck.
119	Barnstead.	Barnstead.	Horace N. Colbath.	Miss Jennie M. Huse.	Miss Nellie Fletcher.
120	Laconia.	Laconia.	J. Frank Crockett.	Mrs. Augusta P. Sanborn.	Miss Bertha H. Flanders.
121	Loudon Surprise.	Loudon.	Abram Bachelder.	W. W. Cate.	Frank A. Brown.
122	Scammell.	Durham.	W. S. Meserve.	Miss Mary A. Burnham.	Lucian Thompson.

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HILLSBOROUGH COUNTY POMONA GRANGE No. 1.

Located in Hillsborough county. Annual meeting, first Tuesday of December at Milford. Quarterly meetings, Tuesdays on or before full moon in March, June, and September. Special meetings are held with the Granges in the county.

Willis H. Abbott, Wilton, Master; Eli C. Curtis, Lyndeborough, Lecturer; Kimball Webster, Hudson, Secretary.

EASTERN NEW HAMPSHIRE POMONA GRANGE No. 2.

Located at Bow Lake, Strafford, for annual meeting. Meets monthly with Subordinate Granges in the jurisdiction, Thursdays on or before full moon, unless otherwise desired by the local Grange. Afternoon sessions are generally public.

George R. Drake, Pittsfield, Master; James M. Hayes, Dover, Lecturer; Dudley B. Waldron, Rochester, Secretary.

MERRIMACK COUNTY POMONA GRANGE No. 3.

Located in Merrimack county. Annual meeting held second Tuesday in December at Concord, where quarterly meetings are held the fourth Tuesdays in March, June, and September. Holds intermediate meetings with the Granges of the county.

Warren Abbott, Webster, Master; H. H. Metcalf, Concord, Lecturer; Walter Sargent, Warner, Secretary.

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